

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction.....	2
II. The Proper Construction of the Disputed Claim Terms.....	4
III. The Proper Construction of Claim 1.....	8
A. “driver input means...for entering data into said computing apparatus, said data including a desired destination”	8
B. “a map database...which distinguishes between physical and legal connectivity”	10
1. English dictionary definitions are inappropriate and unhelpful in the face of specification disavowals and prosecution history disclaimers	11
2. MIT made a clear and unambiguous disclaimer of the prior art in its application and statements to the PTO.....	12
3. “Plain and ordinary meaning” is inappropriate in the face of specification disavowals and prosecution history disclaimers.....	15
4. Harman’s proposed construction covers the preferred embodiment	16
5. Harman’s proposed construction is the “correct construction”	17
C. “discourse generator...for generating discourse”	18
1. Claim 1 does not recite or otherwise require a “discourse model”	19
2. MIT’s inventor’s and expert’s testimony <i>15 years after</i> the patent issued, in the context of litigation, is extrinsic evidence that is inappropriate for claim construction	23
3. MIT’s litigation-inspired position remains internally inconsistent, and MIT’s attempts to bolster its construction through discussion of the prior art misrepresents the prior art and is improper.	24
4. The “discourse generator” is not “the heart of the invention,” as MIT now contends, 18 years later in the context of litigation	28
D. “consulting said map database”	31

TABLE OF CONTENTS (CONT'D)

	Page
E. “functionally connected”	36
F. “computing apparatus”	38
G. “speech generator”	39
 IV. The Proper Construction of Claim 45	 39
A. “at the time the act is to be performed”	40
1. This simple phrase should be given its plain and ordinary meaning.	40
2. Harman’s construction is consistent with the descriptions of the Back Seat Driver in operation; MIT’s construction is not.	41
3. Harman’s proposed construction of claim 45 does not require abrupt or unsafe acts.	42
4. MIT’s proposed construction is fatally vague, and would further render claim 45 indefinite (and thus invalid under § 112) were it adopted.....	44
5. MIT’s construction is a premature attempt at an equivalency infringement argument.....	46
 V. Conclusion	 47

TABLE OF AUTHORITIES

	<u>Page(s)</u>
Cases	
<i>ACTV, Inc. v. Walt Disney Co.</i> , 346 F.3d 1082 (Fed. Cir. 2003).....	9
<i>Altiris, Inc. v. Symantec Corp.</i> , 318 F.3d 1363 (Fed. Cir. 2003).....	3
<i>Amgen Inc. v. Hoescht Marion Roussel, Inc.</i> , 469 F.3d 1039 (Fed. Cir. 2006).....	24
<i>Andersen Corp. v. Fiber Composites, LLC</i> , 474 F.3d 1361 (Fed. Cir. 2007).....	7, 14
<i>Apex Inc. v. Raritan Computer, Inc.</i> , 325 F.3d 1364 (Fed. Cir. 2003).....	15
<i>Bancorp Svcs., LLC v. Hartford Life Ins. Co.</i> , 359 F.3d 1367 (Fed. Cir. 2004).....	44
<i>Beckson Marine, Inc. v. NFM, Inc.</i> , 292 F.3d 718 (Fed. Cir. 2002).....	21
<i>Bell & Howell Document Management v. Altek Sys.</i> , 132 F.3d 701 (Fed. Cir. 1997).....	24
<i>Boss Control, Inc. v. Bombadier Inc.</i> , 410 F.3d 1372 (Fed. Cir. 2005).....	11
<i>Broadcast Innovation, LLC v. Echostar Commc'ns Corp.</i> , 240 F. Supp. 2d 1127 (D. Colo. 2003).....	4
<i>Brown v. 3M</i> , 265 F.3d 1349 (Fed. Cir. 2001).....	40
<i>Buspirone Patent Litig.</i> , 185 F. Supp. 2d 340 (S.D.N.Y. 2002).....	4
<i>Catalina Mktg. Int'l, Inc. v. Coolsavings.com, Inc.</i> 115 Fed. Appx. 84 (Fed. Cir. 2004).....	3
<i>CCS Fitness v. Brunswick Corp.</i> , 288 F.3d 1359 (Fed. Cir. 2002).....	20
<i>Competitive Techs., Inc. v. Fujitsu Ltd.</i> , 185 Fed. Appx. 958 (Fed. Cir. 2006).....	44

<i>Cross Med. Prods. Inc. v. Medtronic Sofamor Danek, Inc.</i> , 424 F.3d 1293 (Fed Cir. 2005).....	9
<i>Datamize, LLC v. Plumtree Software, Inc.</i> , 417 F.3d 1342 (Fed. Cir. 2005).....	44
<i>Ecolab, Inc. v. Paraclipse, Inc.</i> , 285 F.3d 1362, 1375 (Fed. Cir. 2002).....	21
<i>Ekchian v. Home Depot, Inc.</i> , 104F.3d 1299 (Fed. Cir. 1997).....	13
<i>E-Pass Techs., Inc. v. 3Com Corp.</i> , 343 F.3d 1364 n. 5 (Fed. Cir. 2003).....	24
<i>Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.</i> , 535 U.S. 722 (2002).....	32
<i>Fuji Photo Film Co., Ltd. v. Int’l. Trade Commission</i> , 386 F.3d 1095 (Fed. Cir. 2004).....	20
<i>Geneva Pharms., Inc. v. GlaxoSmithKline PLC</i> , 349 F.3d 1373 (Fed. Cir. 2003).....	45
<i>Gentry Gallery, Inc. v. Berkline Corp.</i> , 134 F.3d 1473 (Fed. Cir. 1998).....	7
<i>Glaxo Group Ltd. v. Ranbaxy Pharms., Inc.</i> , 262 F.3d 1333 (Fed. Cir. 2001).....	7
<i>Global Maintech Corp. v. I/O Concepts, Inc.</i> , 179 Fed. Appx. 47 (Fed. Cir. 2006).....	41
<i>Honeywell Intern. Inc. v. Hamilton Sundstrand Corp.</i> , 370 F.3d 1131 (Fed. Cir. 2004).....	32
<i>Invitrogen Corp. v. Biocrest Mfg. L.P.</i> , 424 F.3d 1374 (Fed. Cir. 2005).....	44
<i>Karsten Mfg. Corp. v. Cleveland Golf Co.</i> , 242 F.3d 1376 (Fed. Cir. 2001).....	45
<i>Kopykake Enterprises, Inc. v. Lucks Co.</i> , 264 F.3d 1377 (Fed. Cir. 2001).....	7
<i>Liebel-Flarsheim Co. v. Medrad, Inc.</i> , 358 F.3d 898 (Fed. Cir. 2004).....	7

<i>Lockheed Martin Corp. v. Space Sys./Loral, Inc.</i> , 324 F.3d 1308 (Fed. Cir. 2003).....	9
<i>Markman v. Westview Instruments</i> , 517 U.S. 370 (1996).....	19
<i>MBO Labs., Inc. v. Becton, Dickinson & Co.</i> , 474 F.3d 1323 (Fed. Cir. 2007).....	9
<i>Minn. Mining and Mfg. Co. v. Johnson & Johnson Orthopedics, Inc.</i> , 976 F.2d 1559 (Fed. Cir. 1992).....	13
<i>Novo Indus., L.P. v. Micro Molds Corp.</i> , 350 F.3d 1348 (Fed. Cir. 2003).....	44
<i>Oakley, Inc. v. Sunglass Hut Int’l</i> , 316 F.3d 1331 (Fed. Cir. 2003).....	44
<i>Phillips Petroleum Co. v. Huntsman Polymers Corp.</i> , 157 F.3d 866 (Fed. Cir. 1998).....	9
<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005).....	6, 11, 13, 19, 22, 23, 37
<i>Poly-America, L.P v. GSE Lining Tech., Inc.</i> , 383 F.3d 1303 (Fed. Cir. 2004).....	3
<i>Primos, Inc. v. Hunter Specialties, Inc.</i> 451 F.3d 841 (Fed. Cir. 2006).....	20
<i>ResQNet.com, Inc. v. Lansa, Inc.</i> , 346 F.3d 1374 (Fed. Cir. 2003).....	13
<i>Rheox, Inc. v. Entact, Inc.</i> , 276 F.3d 1319 (Fed. Cir. 2002).....	14
<i>SciMed Life Systems, Inc. v. Advanced Cardiovascular Systems, Inc.</i> , 242 F.3d 1337 (Fed. Cir. 2001).....	11
<i>Seachange Int’l, Inc. v. C-Cor Inc.</i> , 413 F.3d 1361 (Fed. Cir. 2005).....	14
<i>Spectrum Int’l, Inc. v. Sterilite Corp.</i> , 164 F.3d 1372 (Fed. Cir. 1998).....	4, 14, 19
<i>Teleflex, Inc. v. Ficosa North America Corp.</i> , 299 F.3d 1313 (Fed. Cir. 2002).....	15, 20

<i>Turbocare Div. of Demag Delaval Turbomach. Corp. v. Gen. Elec. Co.,</i> 214 F. Supp. 2d 170 (D. Mass. 2002)	45
<i>U.S. Surgical Corp. v. Ethicon, Inc.,</i> 103 F.3d 1544 (Fed. Cir. 1997).....	40
<i>United Carbon Co. v. Binney & Smith Co.,</i> 317 U.S. 228 (1942).....	45
<i>Vas-Cath Inc. v. Mahurkar,</i> 935 F.2d 1555 (Fed. Cir. 1991).....	44
<i>Ventana Med. Sys., Inc. v. Biogenex Labs., Inc.,</i> 473 F.3d 1173 (Fed. Cir. 2006).....	37
<i>Wilson Sporting Goods Co. v. Hillerich & Bradsby Co.,</i> 442 F.3d 1322 (Fed. Cir. 2006).....	5, 45

Statutes

35 U.S.C. § 112.....	9, 44
----------------------	-------

Rules

FED. R. EVID. 702	19
-------------------------	----

I. INTRODUCTION.

MIT and the named inventors of the '685 patent have been publicly promoting and describing their "Back Seat Driver" patent as an "automobile navigation system" patent for more than 18 years. Starting with the Davis thesis title "Voice Assisted Automobile Navigation" and abstract ("The Back Seat Driver is a computer navigation assistant for drivers in a city"),¹ continuing with the patent application title ("Automobile navigation system using real time spoken driving instructions"), then confirmed by the classification the Patent Office assigned the patent,² and repeated by MIT during its almost 18 years of unsuccessful licensing attempts, MIT and its attorneys have consistently referred to the "claimed invention...[as] an 'automobile navigation system.'" Ex. BB at 5.

MIT's attempt to now recast its patent as a "discourse" patent, or any other feat in "computational linguistics" or "discourse theory," is contradicted by the patent itself, the prosecution history and by MIT's own admissions. *See, e.g.*, Ex. U ("[c]laim 1 is ***not directed to a discourse generator but to an automobile navigation system***...the discourse generator of claim 1 does indeed cover 'speech generation features that merely provide simple, pre-recorded phrases.'" (emphasis added)). In stark contradiction to its position in patent prosecution and throughout its attempts to license the patent, MIT ***now*** contends that the alleged invention of the '685 patent is not an automobile navigation system, but, instead, a "discourse generator" that

¹ Ex. I at 2-3. (Exhibits A-CC were included with Harman's March 30, 2007 Opening Brief. Exhibits DD-SS are filed with this response brief)

² Ex. F, at cover page (classifying the '685 patent in U.S. classes 364 and 340, and indicating that those two classes (and their various subclasses) were searched by the Examiner for prior art). Classes 364 and 340 correspond to navigation aspects of "Electrical Computers and Data Processing Systems" and "Communications, Electrical" respectively. Ex. DD. None of the classes/subclasses identified on the face of the '685 patent are computational linguistics or computerized speech classes or subclasses, which was class 395 "Information Processing System Organization" in the 1990-1993 timeframe. Subclass 12 of Class 395 was titled "Graphical or natural language user interface" and encompassed "subject matter . . . wherein presentation of data to the user of the system includes . . . statements in standard English language syntax." Ex. SS.

provides “intelligent, understandable spoken driving directions in real time” and which must be construed to provide “sophisticated instructions of the type generated according to a ‘discourse model’ . . .”³ MIT Br. at 1, 9.⁴ It is this “discourse generator” that MIT now heralds as the “heart of the invention” and a triumph of “computational linguistics” in an attempt to distinguish claim 1 from the voluminous prior art.

But MIT never told the Patent Office that the “discourse generator” was the “heart” of its invention. In fact, during prosecution, MIT represented to the contrary and focused instead on the route-finder and map database. Reversing course, MIT now claims “[t]he key problem solved by the inventors and described in the patent” was “the proper content and timing of the instructions and other messages.” MIT Br. at 17. This is unsupported by the patent itself. The patent identifies the purported inventive aspects or “design goals” as “the Back Seat Driver finds a route for the driver, instead of simply displaying position on a map, tells the driver how to follow the route, step by step, instead of just showing the route, and speaks its instructions, instead of displaying them.” Ex. F at Col. 2, lns. 4-10.

³ Notably, the phrase “real time” appears only in the preamble of claim 1. It is well-established that a preamble is not typically a limitation. Thus, the “real time” language in claim 1 is irrelevant and not part of any alleged invention. See *Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1371 (Fed. Cir. 2003); *Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.* 115 Fed. Appx. 84, 89 (Fed. Cir. 2004); *Poly-America, L.P v. GSE Lining Tech., Inc.*, 383 F.3d 1303, 1310 (Fed. Cir. 2004).

⁴ MIT also tells the Court that Harman’s technical expert, who served as one of the chairs of a 1989 conference, thought the Davis idea was “fresh” and “different.” However, MIT quotes the deposition testimony out of context. Mr. French testified that he “looked at the paper in the context of describing a navigation system and how it operated and recall there seemed to be, from the abstract, nothing particularly different or original in all those aspects of the system. The thing I had not seen before – the only thing that made the paper except for the conference is...the fact that it relied **only** on voice, that – which indicated that to be a pretty thorough approach, if that’s all you have” and “By that time I had seen some systems that used voice. I knew of others in development or described in the literature, some of which had been, you know, demonstrated.” See Ex. EE at 93:3-22; 94:9-13 (emphasis added) (filed under seal). Thus, French’s testimony relates to the use of voice **alone** (i.e., without any visual guidance, such as a map display or arrow indications). No modern, commercial navigation system relies solely on voice. All include some visual guidance, such as a detailed map video display. Davis’ academic theory that voice **alone** was the best approach has been entirely rejected by the commercial industry.

Regardless of how MIT now describes its purported invention, MIT is bound by its representations to the Patent Office, even more so in light of MIT's subsequent statements to accused infringers because they are consistent with the prosecution history but inconsistent with its current position. *See Spectrum Int'l, Inc. v. Sterilite Corp.*, 164 F.3d 1372, 1379 (Fed. Cir. 1998) ("claims may not be construed one way in order to obtain their allowance and in a different way against accused infringers"); *accord In re Bussiprone Patent Litig.*, 185 F. Supp. 2d 340, 355 (S.D.N.Y. 2002) ("[t]here is also an equitable dimension to the test: it prevents applicants from construing claims more narrowly in order to obtain their allowance and then more broadly against accused infringers"); *Broadcast Innovation, LLC v. Echostar Commc'ns Corp.*, 240 F. Supp. 2d 1127, 1132 (D. Colo. 2003).

II. THE PROPER CONSTRUCTION OF THE DISPUTED CLAIM TERMS.

MIT's concessions regarding what existed in the prior art – *i.e.* what MIT claimed in the patent, but was **not** the first to invent – support Harman's proposed claim construction. MIT acknowledges that several limitations of claim 1 were "known" in the prior art at the time of MIT's alleged invention:

- The "computing apparatus," consisting essentially of a "microprocessor that controls the process" (MIT Br. at 2) was not an inventive aspect of the '685 Patent because, before MIT's invention, others were "using [such] slow computers of the time." MIT Br. at 7.
- The "driver input means," consisting essentially of a "'keypad' for entering the destination" (MIT Br. at 2) "was **not part of the invention**...any data entry device would work." MIT Br. at 4 (emphasis added).
- The "position sensing apparatus," consisting essentially of "a GPS receiver or other position sensor" (MIT Br. at 2) was not inventive because people in the "GPS or map-making industries" had done this before MIT. MIT Br. at 9.
- The "location system," consisting essentially of "a software module within the system that takes the GPS or position coordinates, and maps them to the map database, so the system would know where you are on the route" (MIT Br. at

2) was not inventive because “engineers were testing various electronic technologies for tracking vehicles” before MIT. MIT Br. at 7.

- The “route finder,” consisting essentially of “a software module that calculates your route” (MIT Br. at 3) was much like those invented before the ’685 patent when “[o]thers were working on using computers to generate better routes – directions which would take into account things like road types and highway speeds, to provide the best route to a destination.” MIT Br. at 7.
- The “speech generator,” consisting essentially of a “software module that takes the output from the discourse generator, and generates electronic signals to create speech for the driver to hear” (MIT Br. at 3), appeared in Davis’ prior-art Direction Assistance project, which provided “spoken, step-by-step instructions.” MIT Br. at 8.
- The “voice apparatus,” consisting essentially of “speakers in the car that take the electronic signal from the speech generator, and create the sound the driver hears” (MIT Br. at 3) was found in the prior-art systems that MIT acknowledges were capable of speaking at least “rudimentary” instructions to a driver. MIT Br. at 7-8.

Thus, even according to MIT, none of these features contributed to the alleged novelty of the ’685 patent.⁵

⁵ In light of these admissions, MIT’s attempt to introduce infringement arguments through the introduction of a pending patent application (MIT Br. Ex. 7) assigned to Harman (MIT Br. at 12-13), purportedly as part of the “**Background of the ’685 patent**,” is illogical and irrelevant. **First**, the patent application was filed in 2003, **twelve years after** the Back Seat Driver patent issued, and thus cannot relate to the “background” of the invention. **Second**, MIT asserts (an obvious infringement argument) that Figure 2 of this pending patent demonstrates “Harman’s current navigation systems include [components in the Figure].” But MIT has not shown that this patent relates in any way to the accused products, or to any existing Harman products. **Third**, even if MIT were correct, the claims are to be construed without attempting to read on accused products. *Wilson Sporting Goods Co. v. Hillerich & Bradsby Co.*, 442 F.3d 1322, 1326 (Fed. Cir. 2006) (noting that claim construction occurs prior to the “application of the construed claim to the accused process or product” and that “a trial court should certainly not prejudge the ultimate infringement analysis by construing claims with an aim to include or exclude an accused product ...”). However, to the extent that background information concerning prior art navigation system architectures will assist the Court in understanding how one skilled in the art would construe the patent terms, many of the systems (including those discussed by MIT in its brief) included these common navigation system components. For example, the Wootton patent (Ex. FF) filed **9 years prior** to the Back Seat Driver application contained: a driver data entry module with push buttons and keys for data input (Figure 2, nos. 20, 22, 24); vehicle position feedback device (Figure 2, no. 40); map matching performed by the processor (Figure 2, no. 18, Page 3, Ln. 64 - Page 4, Ln. 7); map storage and map data module (Figure 2, no. 26, 28); route finding algorithm performed by the processor, under control of the ROM (Figure 2, nos. 18, 30, Page 4, Ln. 65 - Page 5, Ln. 3); instruction producing means (Page 1, Lns. 42-48); and a sound vocabulary unit (Figure 2, no. 38) for use by the processor in formulating vocal instructions (Page 3, Lns. 59-63). (See generally Ex. FF, Figure 2 and corresponding text).

MIT further acknowledges that several prior-art navigation systems provided spoken directions, but argues those systems lacked an ability to provide “sophisticated” and “intelligent” instructions. MIT Br. at 7-8.⁶ Such “sophisticated” and “intelligent” instructions, however, are *not* recited in claim 1, and MIT’s contrived construction of “discourse” cannot change this. In any event, the prior art includes several examples of navigation systems that provide “sophisticated” and “intelligent” instructions, including at least Wootton, ROGUE, EVA, Nimura, and CARIN. *See* Ex. FF at 6 (Table); Ex. GG at 9 (Figure 6); Ex. R at 100 and 106; Ex. HH at Figure 6; and Ex. II (HAR 205929).⁷

Despite MIT’s attempts to focus this Court on irrelevant, extrinsic evidence, claim construction must comply with the Federal Circuit’s well-established case law. **First**, the claims must generally be viewed in accordance with the ordinary and customary meaning understood by a person of ordinary skill in the art at the time of the invention. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-3 (Fed. Cir. 2005) (*en banc*) (“[i]t is a bedrock principle of patent law that the claims of a patent define the invention to which the patentee is entitled the right to exclude” and “[w]e have frequently stated that the words of a claim are generally given their ordinary and customary meaning. We have made clear, moreover, that the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art . . . at the time of the invention...” (internal citations omitted)). **Second**, the Court must consider the

⁶ Admitting that there were several prior art systems “which provided ... rudimentary messages to the driver” including “spoken output such as ‘left’ or ‘right,’” including *Wootton*, *Zeevi*, *CARIN*, and *EVA*; or other “systems which provided static instructions (such as you would get from MapQuest), and attempted to read them while the driver was driving” like in “real time.”

⁷ The instructions taught in this 1987 videotape, which shows an operational prior-art CARIN navigation system, include: “Welcome to the CARIN System,” “Have a Good Trip,” “Straight Ahead,” “Take Next Turning Left,” “Take Next Turning Right,” “Take Second Turning Right,” “Take Second Exit at Roundabout,” “Traffic Jam Ahead,” “Need Petrol,” “Next Petrol Station Six Kilometers,” and “We Have Arrived.” Ex. II (filed under separate cover).

disclaimers MIT made, in the specification and during prosecution, that the map database was unique because, among other things, MIT maintained “separate but equal representations of physical and legal topology” such that the “route-finder considers only legal paths.” *See Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361, 1374 (Fed. Cir. 2007) (“an applicant’s argument that a prior art reference is distinguishable on a particular ground can serve as a disclaimer of claim scope” (citing *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1477, n.* (Fed. Cir. 1998) (“when applicant distinguishes a reference on multiple grounds, ‘any of those grounds may indicate the proper construction of particular claim terms.’”))); *Kopykake Enter.s, Inc. v. Lucks Co.*, 264 F.3d 1377, 1382 (Fed. Cir. 2001) (‘The prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution.’) **Third**, the Court should not read limitations into the claims, such as the “discourse generator” of claim 1, from the preferred embodiment, and must instead give the term its plain and ordinary meaning of providing “instructions and other messages.” *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004) (“it is improper to read limitations from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.”) **Finally**, the Court must consider the amendments made by MIT during prosecution, and recognize that under Federal Circuit precedent, these amendments narrow claim 1 of the ’685 patent to require specific “connections and interactions” in order to “integrate” the various components. *Glaxo Group Ltd. v. Ranbaxy Pharms., Inc.*, 262 F.3d 1333, 1338 (Fed. Cir. 2001) (“Under this court’s current law, ‘a narrowing amendment made for any reason related to the statutory requirements for a patent will give rise to prosecution history estoppel with respect to the amended claim.’”)

III. THE PROPER CONSTRUCTION OF CLAIM 1.

A. “driver input means...for entering data into said computing apparatus, said data including a desired destination”

Harman’s Proposed Construction: The function for the “driver input means” is “entering data into said computing apparatus, said data including a desired destination.”

MIT’s Proposed Construction: The function for the “driver input means” is “entering data.”

The parties agree that this limitation is a means-plus-function limitation. MIT incorrectly tells this Court that the parties “further agree that the MIT specification discloses several ways to perform the claimed function.” MIT Br. at 23. While the parties *do* agree on the corresponding *structures* disclosed by the specification for the “driver input *means*,” Harman *does not agree* that there are “several ways to perform the claimed *function*.” *Id.* The *only function* is that which was claimed, namely “entering data into said computing apparatus, said data including a desired destination.” *Id.* MIT improperly attempts to broaden the claimed function by citing to the abstract or to language describing preferred embodiments. This Court should reject MIT’s proposed construction, which simply deletes language from the recited function in order to broaden the claim to allow “several ways to perform the claimed function.” Such a construction improperly re-defines and broadens the literal scope of the recited function in this limitation, presumably to support MIT’s future argument for infringement under the Doctrine of Equivalents.⁸

Proper construction of “means-plus-function” limitations under the Patent Act and binding Federal Circuit case law requires that, while a means-plus-function limitation literally

⁸ MIT’s brief fails to correctly comprehend and/or intentionally mischaracterizes Harman’s position with respect to the presence or absence of the “driver input means” in any of its accused systems. MIT Br. at 23. Harman will address the issue of non-infringement at the appropriate time, in light of the Court’s proper construction of the claims, which is a prerequisite to any infringement analysis.

covers “the corresponding structure” in the specification, as well as “equivalents” *of that structure*, a means-plus-function limitation does not literally include any equivalency with respect to the recited *function*. See 35 U.S.C. § 112, ¶ 6 (“Literal infringement of a means-plus-function claim limitation requires that the relevant structure in the accused device perform the identical function recited in the claim...”); accord *Cross Med. Prods. Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1315 (Fed Cir. 2005). The cases MIT cites are in accord. See, e.g., *ACTV, Inc. v. Walt Disney Co.*, 346 F.3d 1082, 1086 (Fed. Cir. 2003) (“this court has noted that § 112, ¶ 6 ‘does not permit limitation of a means-plus-function claim by adopting a function different from that explicitly recited in the claim.’”) Therefore, for literal infringement of a means-plus-function limitation, the ***identical*** function recited in the claim must be exactly performed, meaning a proper construction may not include any function other than what is recited. And claim construction is intended to define the literal scope of the claim; not to read in an equivalency analysis. *MBO Labs., Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1329 (Fed. Cir. 2007) (“A determination of patent infringement requires a two-step analysis: first, the meaning of the claim language is construed, then the facts are applied to determine if the accused device falls within the scope of the claims as interpreted.”); accord *Phillips Petroleum Co. v. Huntsman Polymers Corp.*, 157 F.3d 866, 870 (Fed. Cir. 1998) Simply put, “[t]he function is properly identified as the language after the ‘means for’ clause...” *Lockheed Martin Corp. v. Space Sys./Loral, Inc.*, 324 F.3d 1308, 1319 (Fed. Cir. 2003). Therefore the function is “for entering data into said computing apparatus, said data including a desired destination.” This function, identified in the claim itself, is the function identified by Harman’s claim construction.

MIT’s purported “claim construction” argument regarding the “driver input means” is, not so subtly, an infringement argument for the recited function under the Doctrine of

Equivalents. Harman's non-infringement positions are irrelevant to the claim construction at hand. In any event, MIT argues in its brief that Harman's proposed construction "excludes systems that allow the driver to select a destination." MIT Br. at 23. This is not true. Instead, Harman's construction follows the Patent Act and binding Federal Circuit law which dictate that only those systems performing the *exact* function recited in the limitation can potentially fall within the literal scope of a means-plus-function limitation. MIT Br. at 23. The Court should, therefore, adopt Harman's proposed construction.

B. "a map database...which distinguishes between physical and legal connectivity"

Harman's Proposed Construction: "a database containing map information that includes separate but equal databases for representing each physical and legal connectivity, thereby causing the route-finder to consider only legal paths; this excludes a map database in which legal connectivity is represented as a link attribute."

MIT's Proposed Construction: "a map database that contains information on both physical connectivity and legal connectivity and arranged so that the computing apparatus can gain access to this information."

As an initial matter, Harman wholly disputes MIT's misrepresentations to this Court, on page 29 of its brief, that (1) Harman agrees that its accused systems include the map database claimed in claim 1 of the '685 Patent (in fact, they do not); and (2) that Harman does not dispute MIT's proposed construction of the phrase "functionally connected" in the "map database" limitation (indeed, Harman disputes each of MIT's proposed constructions of "functionally connected" throughout claim 1, *see* Section III, E).⁹

MIT tells the Court it proposes a "plain and ordinary meaning" for the "map database" limitation. But MIT's construction goes much farther by including additional meaning such as

⁹ During the meet and confer process, Harman was very clear about its positions with respect to the proper construction of these claim limitations. MIT's feigned confusion is inexplicable. *See* Ex. E at 2.

“arranged so that the computing apparatus can gain access to this information,” relying on what it calls “a common sense view of what the inventors invented.” MIT Br. at 30, 35. “Common sense” is not the proper standard; instead, the proper construction should reflect “the meaning that the term would have to a person of ordinary skill in the art . . . at the time of the invention” that is the applicable legal standard. *Phillips*, 415 F.3d at 1313. Furthermore, MIT’s arguments that “the prosecution history provides no additional insight into the meaning of [a map database] ‘which distinguishes between physical and legal connectivity’” and that the applicant’s statements during prosecution “do not evince a clear, unmistakable and unambiguous disavowal of the scope of the map database” are demonstrably incorrect. MIT Br. at 35.

1. English dictionary definitions are inappropriate and unhelpful in the face of specification disavowals and prosecution history disclaimers.

Although, when read in isolation, many claim terms deceptively appear capable of being given their broad, plain, and ordinary meaning, the Federal Circuit *mandates* that courts consider the intrinsic evidence to determine whether the applicant narrowed the meaning of any terms in the specification or file history. *See SciMed Life Systems, Inc. v. Advanced Cardiovascular Sys.s, Inc.*, 242 F.3d 1337, 1341 (Fed. Cir. 2001) (noting “[w]here the specification makes clear that the invention does not include a particular feature, that feature is deemed to be outside the reach of the claims of the patent, even though the language of the claims, read without reference to the specification, might be considered broad enough to encompass the feature in question.”); *see also Boss Control, Inc. v. Bombardiere Inc.*, 410 F.3d 1372, 1379 (Fed. Cir. 2005) (noting “the intrinsic evidence binds [the patentee] to a narrower definition...than the extrinsic evidence might support.”). It is well-settled that extrinsic evidence, such as dictionaries, may never be “used to contradict claim meaning that is unambiguous in light of the intrinsic evidence.” *See Phillips*, 415 F.3d at 1324.

In this case, as detailed below, there is a clear and unambiguous disclaimer of the prior art in the specification and prosecution history, thus making MIT's proposed construction, which attempts to supplant this intrinsic evidence with extrinsic dictionary definitions, improper. *Phillips*, 415 F.3d at 1322-23 (noting that dictionaries may be consulted only "so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents.")

2. MIT made a clear and unambiguous disclaimer of the prior art in its application and statements to the Patent Office.

MIT's statements in its opening brief further demonstrate MIT's intent to impermissibly broaden the reach of its claims. MIT tells this Court that "a key teaching of the patent...is the concept of including information about *both* physical and legal connectivity." But this is not, and cannot be considered, a teaching of the patent over the prior art, especially in light of MIT's admissions made during prosecution. MIT's admissions (cited by Harman) made during prosecution and which MIT now characterizes as inconsequential "sound bites" or "snippets" taken out of context, were made in the context of distinguishing the invention from the prior art. MIT Br. at 33-34; Ex. P at 78. In the same disclosure statement, MIT recognized other systems that have both legal and physical connectivity information, *e.g.*, the Calgary system, which MIT admitted included legal topology and physical topology (Ex. P at 77-78); and the EVA system, which required both "graphical position and direction of street segments" as well as "traffic regulations and restrictions relevant to the streets" for the purposes of "determination of the optimal route" and for "output of driving recommendations." Ex. T at 320 (cited by MIT to the Patent Office and admitted to contain "restrictions on turning.")¹⁰

¹⁰ MIT was keenly aware of many prior-art navigation systems that had already dealt with the shortcomings of the DIME file with respect to the inclusion of legal connectivity information. *See generally* Ex. O, Q, R, S, T. That's why MIT deliberately disclaimed each of these systems. *See* Ex. P at 70-78; Ex. O, Q, R, S, T. That is

Following its discussion of several similar prior-art map databases, MIT distinguished its invention with clear and unambiguous representations that “[t]hese [prior art] maps have some questionable design decisions on the representation of legal restrictions... The Back Seat Driver appears to be ***unique in maintaining separate but equal representations for physical and legal topology.***” Ex. P at 78 (emphasis added). “[B]y distinguishing the claimed invention over the prior art, an applicant is indicating what the claims do not cover.” *Spectrum Int’l. v. Sterilite Corp.*, 164 F.3d 1372, 1378-9 (Fed. Cir. 1998) (citing *Ekchian v. Home Depot, Inc.*, 104 F.3d 1299, 1304 (Fed. Cir. 1997)). This is a clear and unambiguous statement, that cannot be so easily dismissed by MIT for the following two reasons.

First, the inventors deliberately designed the map database in this “unique” way in order to solve an efficiency problem. *See* Harman’s Opening Brief at 16-17 (Sec. V.B.3). The claims must therefore be construed in a manner that is consistent with the inventors desire to solve these problems. *ResQNet.com, Inc. v. Lansa, Inc.*, 346 F.3d 1374, 1382 (Fed. Cir. 2003) (“remarks regarding overcoming all problems in the prior art inform the proper claim construction”); *Minn. Mining and Mfg. Co. v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 1566 (Fed. Cir. 1992) (construing claims in light of “problems” the inventor attempted to solve). In the patent specification, MIT explained how its map database improved the efficiency of the system, for example, when discussing the preferred embodiment, noting that the route finder “consider[s] only legal paths.” *Id.*; Ex. F at Col. 5, Ln. 12. MIT’s dictionary-based construction fails to consider (indeed, contradicts) the inventors’ noted efforts to solve this efficiency problem. As such, the use of this extrinsic evidence here is improper. *See Phillips*, 415 F.3d at 1324.

also why MIT described the Back Seat Driver as “unique” in using “separate but equal representations,” of physical and legal connectivity so as to “allow[] the route finder to ***consider*** only legal paths,” which allegedly “not been included in any other navigation system.” Ex. P at 12.

Second, MIT's dictionary and "common sense" based construction would impermissibly broaden the "map database" limitation of claim 1 to include within its claims the prior-art map databases, which merely contained physical and legal connectivity data, and which MIT specifically disclaimed during prosecution. Ex. P at 78. These statements originate in Davis' thesis, where they were deliberately used to describe the alleged invention. Ex. I at 48, 58. More than a year later, MIT also chose to include these statements in its application to the Patent Office – again because they describe the alleged invention. Ex. P at 12, 78. MIT cannot now rewrite its claims and its application to disown the very descriptions MIT deliberately selected and emphasized during prosecution. *See Spectrum*, 164 F.3d at 1379 ('[c]laims may not be construed one way in order to obtain their allowance and in a different way against accused infringers.')

Despite this, MIT argues that its disclaimers during prosecution were not "clear and unambiguous" and may thus be ignored in their entirety. However, the Federal Circuit has "made clear" that "an applicant's argument that a prior art reference is distinguishable on a particular ground can serve as a disclaimer of claim scope even if the applicant distinguishes the reference on other grounds." *Andersen*, 474 F.3d at 1374; *see also Seachange Int'l, Inc. v. C-COR Inc.*, 413 F.3d 1361, 1372-73 (Fed. Cir. 2005) ("[w]here an applicant argues that a claim possesses a feature that the prior art does not possess in order to overcome a prior art rejection, the argument may serve to narrow the scope of otherwise broad claim language."); *Rheox, Inc. v. Entact, Inc.*, 276 F.3d 1319, 1325 (Fed. Cir. 2002) ("[e]xplicit arguments made during prosecution to overcome prior art can lead to narrow claim interpretations.")

MIT is bound by its representations to the Patent Office that "[t]he Back Seat Driver appears to be unique in maintaining separate but equal representations for physical and legal

topology” and “[t]o the inventor’s knowledge, this has not been included in any other navigation system.” Thus, MIT must be held to have meant what it said – none of the systems of which it was aware included such a “map database.” Ex. P at 78; Ex. F at Col. 5 Lns. 12-14. MIT’s statements fall squarely within the Federal Circuit’s definition of a “clear and unambiguous disclaimer.”

3. “Plain and ordinary meaning” is inappropriate in the face of specification disavowals and prosecution history disclaimers.

For much the same reasons that the Court should reject MIT’s dictionary-based construction, the Court should also reject MIT’s suggestion that the Court should apply plain and ordinary meaning to the phrase “a map database...which distinguishes between physical and legal connectivity.” Even assuming the disputed phrase has a generally-accepted “plain and ordinary meaning,”¹¹ that meaning is trumped by MIT’s disavowals and disclaimers in the specification and prosecution history. *Apex Inc. v. Raritan Computer, Inc.*, 325 F.3d 1364, 1377 (Fed. Cir. 2003) (“Claim terms take on their ordinary and accustomed meanings unless the patentee demonstrated an intent to deviate from the ordinary and accustomed meaning of a claim term by redefining the term or by characterizing the invention in the intrinsic evidence *using words or expressions of manifest exclusion or restriction, representing clear disavowal of claim scope.*” (citing *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1327 (Fed. Cir. 2002) (emphasis in original)). Here, the intrinsic evidence confirms that MIT believed it had a unique, different, and better map database that was “the most significant extension” of its alleged invention, and MIT used clear language in claim 1 to recite its special map database:

¹¹ Even MIT’s brief demonstrates that there is no generally accepted meaning for the phrase. Throughout its brief, MIT inconsistently contends the phrase “a map database...which distinguishes between physical and legal connectivity” means either “a map database which knows whether two roads connect and whether turns are legal or not” or “a map database which contains information on both physical and legal connectivity and arranged so that the computing apparatus can gain access to this information.” MIT Br. at 2, 30.

“distinguished between physical and legal connectivity.” Accordingly, this phrase must be given the same meaning that MIT gave it in the specification and prosecution history.

4. Harman’s proposed construction covers the preferred embodiment.

MIT argues that Harman’s proposed construction is improper because it does not cover any preferred embodiments disclosed in the specification, citing as its evidence that “the map database 14 includes, as its basis, a file of 28 segments and nodes.” MIT Br. at 30. MIT is wrong. The specification describes a preferred embodiment of the map database that comports with Harman’s proposed construction. As seen in Figure 3, the map database of the Back Seat Driver included many sub-databases describing the segments and nodes, for example “street quality,” “speed limits,” and “turn difficulty.” As described in the specification, the preferred embodiment’s map database included among its sub-databases a specific sub-database, “a legal connection list” which indicated “all segments which are legally accessible.” Ex. F at Fig. 3; Col. 5, Lns. 9-11.¹² This embodiment thereby “allow[ed] the route finder to consider only legal paths.” Ex. F at Col. 5 Lns. 11-14; Ex. I at 48. In addition, the actual working prototype of the Back Seat Driver, another preferred embodiment, was repeatedly described as “*unique* in maintaining *separate but equal representations for physical and legal topology*.” Ex. P at 78 and Ex. I at 58 (emphasis added). This embodiment too “*allow[ed] the route finder to consider only legal paths*.” Ex. F at Col. 5 Lns. 11-14; Ex. I at 48 (emphasis added).

It was this map database that MIT proclaimed as “*unique* in maintaining *separate but equal representations for physical and legal topology*” that made the alleged invention supposedly different, better, and allegedly “unique,” because it “*allow[ed] the route finder to*

¹² A “no turns list” is the exact opposite of a “legal connections list.” Whereas a “legal connections list” allows the route finder to consider only legal paths, a “no turns list” causes the route finder to consider all paths, legal and illegal, and then rejects the illegal paths at a later juncture based upon the “no turns list.”

consider only legal paths.” See Ex. P. at 78; Ex. F at Col. 5 Lns. 11-12 (emphasis added). “To the inventor’s knowledge, this has not been included in any other navigation system.” Ex. F at Col 5 Lns. 12-14; *accord* Ex. I at 48. These are the words MIT used to describe its preferred embodiment in the specification, file history and Davis’ thesis. Harman’s construction tracks exactly the language used by the inventors:

a database containing map information that includes *separate but equal databases for representing each physical and legal connectivity*, thereby *causing the route-finder to consider only legal paths*; this excludes a map database in which *legal connectivity is represented as a link attribute*.

MIT chose this language to describe its alleged invention to the Patent Office. The descriptions in the specification, file history, the inventor’s own thesis, and MIT’s pre-litigation correspondence¹³ are consistent with Harman’s proposed construction. Indeed, MIT’s argument that its “unique” map database merely “allows,” rather than “requires” the route finder to consider only legal paths is a distinction without a difference and is contradicted by the intrinsic evidence. The “considers only legal paths” feature is not described as an option; the specific arrangement is described as actually allowing (not maybe allowing or optionally allowing) that feature, and any arrangements that do not do so were disavowed in the specification and disclaimed in the prosecution.

5. Harman’s proposed construction is the “correct construction.”

The correct construction, as proposed by Harman, is the construction consistent with both the claim language and the intrinsic evidence. In light of the prior art, MIT *chose* to include in claim 1 a limitation directed to the particular type of map database MIT believed was “unique” – this is the map database that MIT believed it had invented. MIT specifically distinguished the

¹³ MIT’s brief ignores its extensive pre-litigation admissions that the “map database” limitation of claim 1 has a narrow, specialized meaning. Perhaps recognizing that its own pre-litigation admissions were irrefutable, MIT made no effort to address them in its brief. In the event that MIT does so in its response brief, Harman will either seek leave to file a reply, or will address them at oral argument.

map database of claim 1 from the prior-art systems¹⁴ that represented both physical and legal connectivity “with the assumption that legal [connectivity would] be equivalent to the physical [connectivity] unless specifically indicated.” As such, MIT cannot now impose a construction that opposes its own deliberate choices made during the prosecution of its patent. Harman’s construction, which tracks the exact language of MIT’s Patent Office disclaimers is the correct construction.

C. “discourse generator...for generating discourse”

Harman’s Proposed Construction: discourse is simply words to be spoken. As recited in the claim itself, discourse in claim 1 must include “instructions and other messages,” where instructions and other messages include those items described in the specification as such. A discourse generator generates discourse.

MIT’s Proposed Construction: “Discourse generator” means “A module, in software or hardware, which composes driving instructions and other messages according to a discourse model, for delivery at the appropriate time and place, and based on the current position of a vehicle and its planned route.” The term “discourse model” needs further construction, and means “a way to provide information needed by a conversation participant in context to enable the conversation participant to determine why an utterance was provided and what the utterance means.”

As discussed generally in the Introduction section above, MIT’s latest recitation of the purported inventive aspect of the ’685 patent is a result of MIT’s discovery-driven acknowledgement that the Back Seat Driver was, in fact, *not* the first speaking navigation system. *See* MIT Br. at 7-8. Indeed, in light of the prior art produced in this case, MIT now concedes that all but one of the purported features of the ’685 Patent were known at least as early

¹⁴ MIT’s attempts now to cloud the issue with litigation-inspired statements such as “map databases available to Davis and Schmandt when they made their invention lacked *legal* connectivity information.” MIT Br. at 31. The statement is contrary to the record and is further not supported by MIT’s citation to the shortcomings of the DIME map database. Indeed, in its application MIT identified other prior art systems containing legal connectivity information as having “features beyond those present in the DIME format” including legal connectivity information. Ex. P at 77.

as 1989.¹⁵ This explains MIT's newly adopted position that the "invention of the '685 patent *combined* principles from computational linguistics, natural language processing, and discourse theory (including discourse generation), with *known automobile navigation technology* to generate driving instructions modeled after those given by people." MIT Br. at 10 (emphasis added). MIT's new line of attack, however, contradicts the positions MIT took during prosecution and during its failed attempts at commercialization and licensing of the '685 patent. MIT should not be permitted to continually redefine its invention; instead, the "patent define[s] the invention to which the patentee is entitled the right to exclude." *Phillips*, 415 F.3d at 1312; *see also Spectrum*, 164 F.3d at 1379.

1. Claim 1 does not recite or otherwise require a "discourse model."

MIT's proposed construction is improper because claim 1 does not recite or otherwise require a discourse model. *Phillips*, 415 F.3d at 1312 ("It is a 'bedrock principle' of patent law that the 'claims of a patent define the invention to which the patentee is entitled the right to exclude.'") MIT's contention that the "discourse generator" requires a "discourse model" like the one developed by MIT's expert, Dr. Grosz,¹⁶ is simply incorrect. As noted in Harman's opening brief, the specification section cited by MIT as discussing the "discourse generator" is largely irrelevant to the construction of claim 1. That section is a description of the *preferred embodiment*, which relates to the dependent claims. *See id.* at 1314-15 ("Differences among

¹⁵ *See* MIT Br. at 17 ("The discourse generator element is the heart of the invention, because it is what makes the invention special and unique.")

¹⁶ Harman generally objects to MIT's unsolicited expert testimony, which is inappropriate for purely legal issues such as claim construction, unless requested by the Court. *See* FED. R. EVID. 702; *Markman v. Westview Instruments*, 517 U.S. 370, 389 (1996) ("judges...are better suited to find the acquired meaning of patent terms."); *Phillips*, 415 F.3d at 1318-19 (extrinsic evidence is unreliable and only proper where consistent with intrinsic evidence and required to explain an ambiguity). Harman further objects to MIT's mischaracterization of the opinions and testimony of Harman's expert Dr. Litman. While not relevant to the issue at hand, Dr. Litman's opinions are entirely consistent with the use of the term "discourse" in the '685 Patent, as well as her other scholarly writings.

claims can also be a useful guide in understanding the meaning of particular claim terms. The presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.” (citations omitted)). And, as noted previously in Harman’s response, preferred embodiments are not part of the claim. *Teleflex*, 299 F.3d at 1327 (citing *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (noting that the patentee cannot overcome the ‘heavy presumption’ that a claim term takes on its ordinary meaning simply by pointing to the preferred embodiment in the specification.)); accord *Fuji Photo Film Co. v. Int’l. Trade Commission*, 386 F.3d 1095, 1105 (Fed. Cir. 2004). The patent describes Grosz’s discourse model as merely a “preferred” embodiment. Ex. F at Col. 23, Ln. 6. As such, that limitation does not belong in a proper construction of claim 1. MIT’s litigation-inspired argument that “*discourse*” requires a “*discourse model*” is the fruit of MIT’s cherry-picking expedition through the patent specification in response to Harman’s prior art and non-infringement arguments. This is improper. See *Primos, Inc. v. Hunter Specialties, Inc.*, 451 F.3d 841, 848 (Fed. Cir. 2006) (noting that the court “cannot import limitations from the preferred embodiments into the claim...”). Furthermore, rather than define a “discourse model” in the same way that the term is defined in the two computational linguistics articles incorporated into the specification, MIT instead manufactures its own, subjective (and unsupported) definition independent of this phrase. MIT does this because it knows that no commercial navigation system utilizes (or will ever utilize) the extremely narrow “discourse model” theory disclosed in Dr. Grosz’s academic study. Allowing MIT to re-define “discourse model” in a “MIT-knows-it-when-it-sees-it” fashion, does not put the public on notice of the scope of claim 1 of its patent, and would therefore defeat the entire purpose of the patent system. See *Phillips*, 415 F.3d at 1312 (“the claims of a patent

define the invention to which the patentee is entitled the right to exclude.” (quotations and citations omitted)); *Spectrum*, 164 F.3d at 137 (“[t]he public has a right to rely on the patentee’s definitive statements.”). MIT cannot now, in an effort to avoid invalidity, go back and import extraneous features from the preferred embodiment and dependent claims into claim 1.

To the extent any particular type of discourse is claimed in the ’685 patent, that is only true with respect to the dependent claims. *See, e.g.*, claim 41 (discourse generator based on an “object oriented programming methodology”); claims 42-44 (discourse generated depending upon “intersection type” from a “taxonomy of intersection types”); claim 45 (long and short descriptions); claim 46-47 (discourse using long and short descriptions with “cues”); claim 48 (discourse generator that can also generate immediate instructions, or repeat or clarify instructions on demand); claim 51 (discourse based on a recorded history of the route to use this context to generate future cues and to make future discourse more understandable); and claim 54 (discourse is customized according to a user model based on driver preferences and requirements). But the limitations recited in the dependent claims cannot properly be read into independent claim 1. *See Beckson Marine, Inc. v. NFM, Inc.*, 292 F.3d 718, 723 (Fed. Cir. 2002) (finding that the district court erred in claim construction “by importing limitations from the specification and from dependent claims...”); *Ecolab, Inc. v. Paraclipse, Inc.*, 285 F.3d 1362, 1375 (Fed. Cir. 2002) (“each claim in a patent is presumptively different in scope.”)

Even Davis’ thesis confirms that no “discourse theory” or other specialized discourse is required for the discourse generator of claim 1. In the section of the thesis discussing the discourse generator, the inventor describes a very simple concept: “The basic process is to look ahead at the route and decide what action the driver must take to follow it, then form sentences that tell the driver about these actions, uttering them at appropriate times.” Ex. I at 63. Then, in

subsequent, separate sections, Davis elaborates and describes the special features recited in the dependent claims, such as: the use of “cues,” “landmarks,” and “street names” for telling the driver “when to do it,” (*id.* at 8, 71-75), discourse using a “taxonomy of intersection types” (*id.* at 64); “long,” “brief,” and “short” descriptions (*id.* at 70); and “keep[ing] track of what has been mentioned.” (*id.* at 32) (discussing the use of a recorded history of instructions to provide context). None of these features are required for “discourse” in claim 1, which the inventor separately described in a different section of the thesis (*id.* at 3, 77) and recited in other, dependent claims.

Indeed, MIT itself plainly understood long ago that none of these detailed types of directions were required in claim 1, as evidenced by MIT’s statement to its research sponsor that “Any navigation system in the U.S. that gives spoken instructions is covered by their patent.” Ex. JJ at 0003 (filed under seal); Ex. KK at 98:16-18 (filed under seal). Separately, MIT’s patent counsel (who was engaged specifically to respond to Harman’s *prima facie* case of invalidity) admitted discourse was simply “extended verbal expression in speech or writing.” Ex. BB at 10. This is consistent with MIT’s prosecution counsel’s description of discourse as “simple, pre-recorded phrases.” Ex. U. Thus, MIT’s own pre-litigation admissions simply do not support MIT’s new, litigation-inspired requirement that the “discourse generator” *requires* “sophisticated” and “intelligent” discourse, from the “*preferred*” discourse model. Instead, the “discourse generator” in claim 1 simply requires a module that generates “instructions and other messages” in accordance with its plain and ordinary meaning.

In contrast to its contrary assertions, MIT’s proposed claim construction is a response to prior art and invalidity concerns. Harman’s construction is dictated, as required by the Federal Circuit’s *en banc* decision in *Phillips*, by consideration of (1) the nature of the discourse

generator limitation as recited in claim 1, (2) the content of the dependent claims, (3) the intrinsic record, and (4) the pre-litigation correspondence. MIT's proposed construction relies upon a new, litigation-inspired argument that the "discourse generator" *requires* "sophisticated" and "intelligent" discourse, and that that "discourse" must follow a confusing and academic, "*preferred*" discourse model. *See* Ex. F at Col. 23, Ln. 6. This is not supported by the claim language, which dictates that the "discourse generator" of claim 1 is simply a software module that provides discourse including "instructions and other messages."

2. MIT's inventor's and expert's testimony *15 years after* the patent issued, in the context of litigation, is extrinsic evidence that is inappropriate for claim construction.

In construing "discourse generator," MIT relies extensively on self-serving testimony by one of the inventors and by MIT's expert witness in an effort to contradict the intrinsic evidence. For example, MIT attempts to bolster its importation of limitations from the preferred embodiment with testimony of its expert, Dr. Grosz (admittedly not a person of ordinary skill in the art).¹⁷ *Phillips*, 415 F.3d at 1318 ("conclusory, unsupported assertions by experts as to the definition of a claim term are not useful to a court" and "extrinsic evidence consisting of expert reports and testimony is generated at the time of and for the purpose of litigation and thus can suffer from bias that is not present in intrinsic evidence. The effect of that bias can be exacerbated if the expert is not one of skill in the relevant art or if the expert's opinion is offered in a form that is not subject to cross-examination.") MIT's reliance on expert testimony is

¹⁷ MIT's experts define a person of ordinary skill in the art as "a master's degree in computer science, or have a bachelor's degree in computer science with several years of computer programming experience. This person would also have general knowledge and experience with speech processing, database design and global positioning." Ex. LL at 5 (filed under seal). Dr. Grosz freely admitted that she does not meet this definition and that "No, I do not have expertise in navigation systems." Ex. MM at 35:18-36:19 (filed under seal). Indeed, Dr. Grosz's extensive experience in the academic realm of linguistics theory makes her opinions irrelevant to the matter at hand, which is focused on how others of *ordinary* skill in a *different* art would read and understand the patent.

improper under Federal Circuit precedent. It is well settled that, in construing patent claims, the Court must first be guided by the patent claims themselves (not the self-serving constructions of the parties before it) and must ordinarily give the claims their “ordinary and customary meaning.” *Id.* at 1312-14. From there, Courts can consider the intrinsic evidence. *Id.* at 1317. Only if the claim is still ambiguous, after considering the intrinsic evidence, may the Court consider extrinsic evidence to determine the meaning of the claims. *Id.* at 1318. To the extent that inventor testimony is at odds with the claims and the intrinsic evidence, it is irrelevant. *See id.* at 1319.

MIT’s attempt to read its inventor’s and expert’s interpretations into the construction of “discourse generator” in claim 1 are self-serving and thus improper as a matter of law. *See Amgen Inc. v. Hoescht Marion Roussel, Inc.*, 469 F.3d 1039, 1044 (Fed. Cir. 2006) (“[g]iven this court’s rule toward limited reliance on extrinsic evidence in claim construction, district court judges have learned to disclaim any reliance on expert testimony” (internal citations omitted)); *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1370, n. 5 (Fed. Cir. 2003) (“this court has often repeated that inventor testimony is of little probative value for purposes of claim construction.”); *Bell & Howell Document Management v. Altek Sys.*, 132 F.3d 701, 706 (Fed. Cir. 1997) (“The testimony of an inventor and his attorney concerning claim construction is thus entitled to little or no consideration. The testimony of an inventor is often a self-serving, after-the-fact attempt to state what should have been part of his or her patent application...”)

3. MIT’s litigation-inspired position remains internally inconsistent, and MIT’s attempts to bolster its construction through discussion of the prior art misrepresents the prior art and is improper.

MIT’s construction of this limitation is inconsistent even within its own Opening Brief. Depending on where you look in MIT’s brief, the “discourse generator” of claim 1 is allegedly and varyingly: (1) something that “provide[s]...*instructions and other messages* ‘as a passenger

in a car familiar with the route would;” (2) something that creates “a dialogue between the user and the speaker, where one sentence has meaning in the context of earlier sentences;” (3) something that “includes the software algorithms that determine what to say and when to say it based on the driver’s position and the route;” or (4) “a module, in software or hardware, which composes driving *instructions and other messages* according to a discourse model, for delivery at the appropriate time and place, and based on the current position of a vehicle and its planned route.” MIT Br. at 4, 17, 20 (emphasis added). Or, perhaps MIT intends to go with its (fifth) “more simple definition,” which consists of “a software module that takes the route, and determines what should be said to the driver, and when.” MIT Br. at 3. Or, at the other end of the spectrum, MIT argues another (sixth) interpretation that it alleges the “[t]he inventors made clear in the patent” (MIT Br. at 18) (citing Ex. F Col. 3. Lns. 35-38; Col. 23 Lns. 6-32):

Based on the current position of the automobile and the route, the discourse generator [] composes driving *instructions and other messages* according to a discourse model in real time as they are needed... The discourse model preferred for the Back Seat Driver is a partial implementation of the discourse theory described by B.J. Grosz and C.L. Sidner (“Attention, intentions, and the structure of discourse” in *Computational Linguistics*, 12(3):175-204, 1986) and the theory of intonational meaning described by J. Hirschberg and J. Pierrehumbert (“The intonational structuring of discourse” in *Proceedings of the Association for Computational Linguistics*, 136-144, July 1986). Both of these articles are herein incorporated by reference. This model allows the program (or programmer) to create and manipulate discourse segments. The program specifies the contents of the discourse segment (both the syntactic form and the list of objects referenced) and the implementation of the model does the following: generates prosodic features to convey discourse structure; inserts discourse segment into intentional structure; and maintains attentional structure — adding new objects when mentioned and removing old objects ‘when replaced. In addition it includes some useful low-level tools for natural language generation: search of attentional structure for occurrence of co-referential objects; conjugation of verbs; generation of contracted forms; and combination of sentences as “justification” sentences (e.g. “get in the right lane because you are going to take a right.”) and sequential sentences (“Go three blocks, then turn left”). In order to use the discourse package the programmer must explicitly declare all semantic types used by the program, so in this case there are declarations for all objects which pertain to driving such as street names, bridges, rotaries, stop lights and so on.

MIT Br. at 18-19 (emphasis added).

Remarkably, MIT tells this Court that this 281-word paragraph “is precisely the definition MIT seeks here – nothing broader, and nothing narrower.” MIT Br. at 18. MIT does not even attempt to explain why a person of ordinary skill in the relevant art of navigation systems would have *necessarily* understood the two words “discourse generator” in claim 1 to *inherently* include each of these 281 words (not to mention the more than 50 pages of academic theory found in the two articles incorporated by reference). Notably, none of the six interpretations that MIT argues for in its brief match its proposed construction for the “discourse generator.” See MIT Br. at 17-19. Ultimately, and despite their inconsistencies, all of MIT’s various interpretations have one thing in common – none is supported by the claim language or the intrinsic evidence.

The reason for MIT’s inconsistent interpretations can be ascertained from the prior art. The lengthy and contrived construction that MIT proposes is so unwieldy and difficult to comprehend that where convenient for MIT, it describes the “discourse generator” as simply “a software module that takes the route, and determines what should be said to the driver, and when.” MIT Br. at 3. “In particular, the ’685 patent describes an automobile navigation system that knows ‘what to say (content) and when to say it (timing).’” MIT Br. at 10. However, as MIT is aware, many prior art systems would meet the limitation under this construction.

Therefore, despite its numerous interpretations, MIT asks the court to construe the simple phrase “discourse generator” with contrived complexity, incorporating unnecessary and unsupported limitations so as to require “a discourse model” which “provide[s] information needed by a hearer conversation participant in context to enable the hearer conversation participant to determine why an utterance was provided and what the utterance means. A

discourse model provides contextual information and the discourse state to enable a speaker conversation participant to know what to say and how to express it.” MIT Br. at 17.

This is a transparent attempt to artificially distinguish the discourse generator of the Back Seat Driver from that in the prior art, which MIT acknowledges determined and provided “content” (*i.e.*, “what should be said to the driver”) such as “turn right.” MIT Br. at 7-8. However, MIT’s assertion that other systems only gave simple turn instructions, is incorrect. For example, in a footnote, MIT tells the court that the operational CARIN system “only gave turn instructions such as “turn left.” However, in a video dated more than two years prior to MIT’s Back Seat Driver application, the *operational* CARIN system can clearly be heard to provide instructions and other messages such as “have a good trip,” “take second exit at roundabout,” “take first turning right,” “traffic jam ahead,” “next petrol station six kilometers,” and “we have arrived.” Ex. II.¹⁸ In fact, when the application was filed, there were several prior art systems that provided content, including Davis’ own Direction Assistance,¹⁹ which provided “content” via “spoken, step-by-step instructions.” MIT Br. at 8.

Furthermore, other prior-art systems, including some of those discussed above, determined and provided “timing” information (*i.e.*, “when” to say an instruction). Examples include the CARIN system (“take next turning right”) (*see* Ex. II); the EVA system (“Stay in the Right Lane”) (*see* Ex. R at 100); and the Wootton system (“Guidance instructions to be transmitted to the driver...are coordinated with the progress...of the vehicle along the selected

¹⁸ In the same footnote, MIT similarly misrepresents the instructions and other messages provided by several other prior art systems.

¹⁹ In 1988, MIT created a video to promote Direction Assistance. *See* Ex. NN (filed under separate cover).

route...”) (*see* Ex. FF at 3). Thus, the prior art further teaches that such instructions be given “in real time.”²⁰

Recognizing the potential for invalidation of its patent in light of the prior art, MIT now seeks to distinguish the Back Seat Driver in the only way possible, by construing the simple phrase “discourse generator” as artificially containing limitations requiring that the instructions and other messages be “in real-time according to a sophisticated set of linguistic rules.”

4. The “discourse generator” is not “the heart of the invention,” as MIT now contends, 18 years later in the context of litigation.

Davis and Schmandt and MIT’s attorneys publicly promoted, discussed, asserted, and interpreted their Back Seat Driver system and the ’685 patent for more than 15 years before MIT even knew about the existence of Harman’s products. During that period, MIT described its invention as an “automobile navigation system that provided spoken directions” without mentioning any particular computational *linguistics* or discourse *model*. That understanding is reflected in (1) Davis’ thesis titled “Voice Assisted Automobile Navigation” and notes that “The Back Seat Driver is a computer navigation assistant for drivers in a city;”²¹ (2) MIT’s patent which is titled “Automobile navigation system using real time spoken driving instructions;” and (3) the Patent Office’s classification of the patent in the navigation subclasses of the fields

²⁰ *See* Ex. FF at Abstract (noting that the patented system discloses a “[r]oute selection and guidance apparatus for a vehicle...each instruction being announced to the driver when a vehicle-position feedback signal from a feedback device...corresponds with a position reference signal contained in the instruction.); Ex. GG at 2 (noting “The ROGUE software provides to the driver an analog of a knowledgeable passenger giving driving directions both through the use of spoken instructions and in giving its guidance when and where driving actions are needed.”); Ex. R at 100 (“the system technology is developed to not only provide a visual display to direct the driver to his desired destination, but to ‘audibly’ guide him, literally from corner to corner on his drive. A voice-synthesized audio system tells the driver, in clear, concise tones, to ‘Stay in the Right Lane’, or to ‘Please Turn Right at the Next Corner.’”); Ex. W at 317 and Abstract (noting “During the journey, CARIN speaks through a speech synthesizer to tell the driver which road to take at crossings and road junctions.”).

²¹ Ex. I at 2-3.

“Electrical Computers and Data Processing Systems” and “Communications, Electrical,” and not in any of the fields of computational linguistics.

Indeed, MIT’s patent prosecution counsel summarized the “heart of the invention” as simply an “automobile navigation system,” or “a workable navigation system.” Ex. BB at 5, 7; *see also* Ex. U (stating “[c]laim 1 is ***not directed to a discourse generator but to an automobile navigation system*** one element of which is a discourse generator.” (emphasis added)). In its letter and enclosed claim charts seeking to enforce the ’685 patent against Alpine Electronics, Inc., MIT did not even address the discourse generator, finding infringement where the Alpine system “uses the results of the discourse generator for translating the instructions into speech.” Ex. OO (filed under seal). Indeed, until its opening brief, MIT had never publicly described the ’685 patent as a “discourse” patent, or a feat in the area of “computational linguistics” or “discourse theory.”

The public-notice function of a patent does not permit MIT to change the so-called “heart of its invention,” at its whim, to suit its litigation needs. The most relevant facts are found in the intrinsic evidence, beginning with the claim language, where MIT has been telling the public for the past 18 years that all that is required for claim 1 is “discourse” in the form of “instructions and other messages for directing the driver to the destination from the current position.” Indeed, MIT’s own alleged navigation expert admits the dependent claims recite nothing more than routine design choices that were well-known in the field of navigation in 1987-88.²²

²² *See, e.g.*, Ex. PP (filed under seal) at:

- 172:17-20 (admitting it was obvious in 1987-88 to use a map database based on the DIME file in connection with navigation); *compare* ’685 patent, claims 3-4.
- 172:21-24 (admitting it was obvious in 1987-88 to use a map database based on the TIGER file in connection with navigation); *compare* ’685 patent, claim 6.

-
- 173:18-24 (admitting it was obvious to one of ordinary skill in the art in 1988 to use a three-dimensional map database in an automobile navigation system); *compare* '685 patent, claim 7.
 - 173:25-175:11 (admitting that one of ordinary skill in the art in the field of navigation in 1987-88 would have known to include street classifications in a map database for use in a navigation system, and that it was obvious); *compare* '685 patent, claim 8.
 - 176:11-23 (admitting it would it have been obvious to one of ordinary skill in the art in the field of navigation back in 1987-88 to include divided streets in a navigation system map database); *compare* '685 patent, claim 9.
 - 178:23-179:5 (admitting it would have been obvious in 1988 for one of ordinary skill in the art in the field of navigation to include landmarks such as signs, traffic lights, stop signs, and buildings in a map database for automobile navigation systems); *compare* '685 patent, claim 10.
 - 180:21-181:9 (admitting that including speed limits in the map database was obvious to those of ordinary skill in the art in the field of navigation in 1987-88); *compare* '685 patent, claim 12.
 - 181:10-182:1 (admitting that including expected rate of travel in a map database (as that phrase is used in the patent) was obvious in 1987-88); *compare* '685 patent, claim 13.
 - 72:1-20 (admitting that including points of interest in a navigation system was obvious and constituted the "state-of-the-art" in 1987-88); *compare* '685 patent, claims 19-20).
 - 73:13-18 (admitting that it was well-known in 1987-88 to those of ordinary skill in the art to use a best-first-search algorithm like Dijkstras or A* in connection with route finding for a navigation system); *compare* '685 patent, claims 24-25.
 - 52:21-24 (admitting that people in the navigation field in 1987 would have been familiar with the dead reckoning systems for use in navigation); *compare* '685 patent, claim 32.
 - 53:17-21 (admitting that people of ordinary skill in the art in the field of navigation would have known in 1987 that you could use map matching in a navigation system); *compare* '685 patent, claim 34.
 - 84:6-10 (admitting it was obvious in 1987-88 in the field of navigation to use an odometer as a dead reckoning displacement sensor, and that "that's what everybody did" at the time); *compare* '685 patent, claims 35-36.
 - 52:25-53:5 (admitting that people of ordinary skill in the art in the navigation field in the 1987 time frame would have known that you could use a compass for determining direction of an automobile and a navigation system); *compare* '685 patent, claims 35, 37.
 - 53:6-11 (admitting that people of ordinary skill in navigation systems back in 1987 would know that you could use a differential odometer for determining direction in a dead reckoning system for a navigation system); *compare* '685 patent, claims 35, 39.
 - 53:12-16 (admitting that people of ordinary skill in the art in the field of navigation would have known that you could use a gyroscope for a dead reckoning navigation system); *compare* '685 patent, claims 35, 40.
 - 212:12-213:8 (admitting it was obvious to those of ordinary skill in the art in the field of navigation back in 1987-88 to use a text-to-speech synthesizer to generate speech for use in a navigation system); *compare* '685 patent, claim 55.
 - 57:2-7 (admitting that one of ordinary skill in the art in the field of navigation in 1987 would have known that you could use digitized speech to provide spoken instructions in a navigation system); *compare* '685 patent, claim 56.

Now, 18 years later, forced to explain its invention in light of significant and extensive prior art, MIT has finally acknowledged that Davis and Schmandt, in fact, did not invent the first speaking navigation system. MIT Br. at 1, 8-9.²³ Rather than accept certain invalidity of its patent, MIT has suddenly found a new “heart” for its invention by trying to read into claim 1 additional “discourse” limitations that, before today, were merely part of a potential, optional embodiment. Ex. F at Col. 23 Lns. 6-37. This Court should not be tricked by MIT’s latest change of heart.

D. “consulting said map database”

Harman’s Proposed Construction: “for the purpose of seeking or requesting information from said map database.”

MIT’s Proposed Construction: “using, referring to, or relying on data in said map database, without requiring direct access or connection to the map database.”

MIT misrepresents Harman’s position with respect to the proposed construction of “consulting said map database,” as well as the true nature of the parties’ dispute. Specifically:

MIT’s Argument	Harman’s Response
MIT argues that Harman “seeks a special definition for this element by inserting the word ‘directly’ in front of ‘consulting.’” MIT Br. at 36.	Harman’s proposed construction does not contain the word “directly.”
Harman’s construction requires that the location system access “the entire map database.” MIT Br. at 36.	Harman’s proposed construction does not contain the word “entire.” ²⁴

²³ Furthermore, as will be explained, if necessary, in Harman’s summary judgment motions, Davis and Schmandt was also not the first to invent spoken navigation systems that include detailed discourse in the form recited in asserted claim 45. Such a system was already well-known and described in several printed publications more than one year before the filing of the ’685 patent.

²⁴ In other words, Harman’s construction requires that “said map database” be consulted. As long as “said map database” is being consulted, Harman’s construction does not require that each and every bit of data stored in the map database be consulted on each occasion that such consultation is recited in the claim.

MIT's Argument	Harman's Response
MIT devotes significant argument directed to the meaning of the word "consulting." MIT Br. at 37-38.	The word "consulting" is not the issue. The parties' dispute relates to <i>which</i> component must perform the act of "consulting," and which component must be consulted. The claim language itself resolves this issue.

Claim 1 could have been drafted to only require that the system as a whole (rather than a specifically recited component), make use of certain data that originates with the map database in the overall process (rather than consulting "said map database"), but that is not what MIT did. It is well settled that claim construction requires determining the literal scope of the language actually used by the patentee. The issue of what may or may not be an equivalent to the recited claim language is a potential issue for a later infringement analysis.²⁵

Harman's proposed construction recognizes the import of the actual language in claim 1 that explicitly requires that "said map database" be consulted. Furthermore, this explicit language was added specifically to address the Examiner's rejection of the claims for lacking "clearly recited connection/interaction" between the system components. *See* Ex. P at 97.

MIT's brief diverts the Court's attention to the word "consulting," the meaning of which is not truly in dispute. Indeed, MIT's cited dictionary definitions support Harman's position that the word "consulting" has its plain and ordinary meaning of "[f]or the purpose of seeking or requesting information from." *See* MIT Br. at 36-37 (noting that dictionary definitions of "consult" include "[t]o seek advice or information of..." and "seek information from,"

²⁵ Here, however, MIT is not entitled to any scope of equivalents for the "consulting said map database" limitation because this amendment was made specifically to overcome a rejection under 35 U.S.C. § 112. Ex. P at 108-110. An amendment made for the purposes of 35 U.S.C. §112 bars the application of the doctrine of equivalents to the amended portion of the claim. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 535 U.S. 722, 736-737 (2002). A patentee who narrows a claim as a condition for obtaining a patent disavows his claim to the broader subject matter. *Honeywell Intern. Inc. v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1142 (Fed. Cir. 2004). MIT cannot properly be permitted to circumvent the *Festo* bar to equivalents by capturing any alleged equivalency through the process of construing the literal scope of the claim.

definitions that support Harman's proposed construction of "consulting" namely "for the purpose of seeking or requesting information from.") By misdirecting the Court's focus on interpreting the word "consulting," MIT ignores, and tries to read out of claim 1, the clear requirement that particular components consult "said map database."

Even the passages MIT cites from the patent specification do not support MIT's proposed construction. *First*, on page 37 of its brief, MIT cites to a phrase taken out of context, in order to argue that the specification teaches that the "said map database" being consulted by the location system need not be the same "said map database" used by the rest of the system. However, when read in context, MIT's cited phrase establishes that, while such an arrangement with two map databases is technically possible, and was used by MIT in connection with an early prototype for purposes of convenience, that arrangement is not what is claimed in claim 1:

In the working prototypes, a unit built by NEC Home Electronics, Ltd. is employed. It is a dead-reckoning position keeping system which uses speed and direction sensors. To compensate for error it uses map matching on a map database stored on CD-ROM... As implemented in the working prototypes, *the map database used by the location system is completely distinct from the map database used by the route finder and discourse generator*. This is unfortunate since the maps will not always agree unless they are kept equally up-to-date. However, in other embodiments within the scope of the invention, the location system uses the computing resources and map database of the main computing apparatus illustrated in Figure 1.

Ex. F at Col. 12 Ln. 63-Col. 13 Ln. 13 (emphasis added, and portion cited by MIT in its brief italicized).

MIT's *second* contrived citation to the specification appears later on that same page of its brief (page 37), where MIT cites to the Abstract of the '685 patent to support an argument that the word "consult" in the context of "consulting said map database" should be broadly construed to mean "make use of" data that may have originated at some point in time from the map database or be somehow based on such data:

The vehicle location system accepts input from a position sensor which measures automobile movement (magnitude and direction) continuously, and *using this data in conjunction with the map database*, determines the position of the automobile.

Ex. F at Col 13, Lns. 5-8.

MIT Br. at 37 (MIT's emphasis). However, the phrase "using this data" in this passage refers not to the "said map database" data, but to the data that is acquired by the location system's position sensors. The "location system" limitation of claim 1 only requires that the location system "accept data from said position sensing apparatus," which is consistent with the portion of the Abstract MIT cites. However, claim 1 does not discuss using or accepting data from the vehicle location system or position sensor; instead, it expressly requires "consulting *said* map database." *See* Ex. F at claim 1.

MIT also mistakenly relies on Figures 1 and 3 of the patent to support its argument that "[t]he patent makes clear that data from the map database is available to the components of the claimed invention *via the computing apparatus*." MIT Br. at 37 (emphasis added). Figure 1, however, demonstrates that all of the relevant system components, including "said map database" 14 are all *within* the computing apparatus 10, and does not show any intervening processes or structure between "said map database" and the components that must consult it, namely, the "location system" 12, the "route finder" 16, and the "discourse generator" 20:

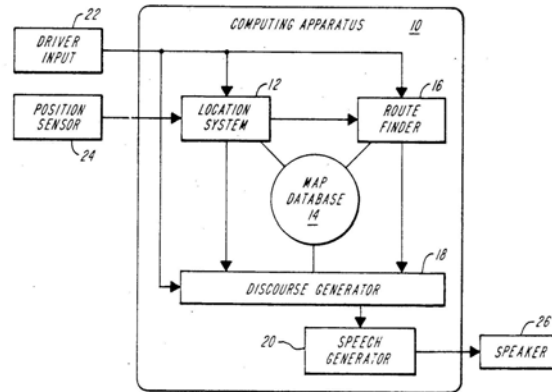


FIG. 1

Figure 1 also shows that other system components that claim 1 does not require to “consult[] said map database” (i.e., the “driver input” 22, “position sensor” 24, “speech generator” 20, and “speaker”/voice apparatus 26) are separated from “said map database” by other intervening processes and/or structure. Thus, Figure 1 does not support MIT’s argument that “[t]he patent specification allows for map data to be communicated to components of the navigation system indirectly.” MIT Br. at 37. The patent figures support Harman’s proposed construction, not MIT’s.²⁶

The phrase “consulting said map database” is properly construed in accordance with its plain and ordinary meaning, requiring that *said map database* must be consulted. MIT cannot construe this phrase as meaning that *something other than said map database* may be consulted, because such a construction drastically departs from the plain and ordinary meaning of the phrase and is not supported by the claim language itself or the intrinsic evidence. Furthermore, MIT’s proposed construction is improper in light of MIT’s amendments to claim 1 during prosecution which added this exact language in order to overcome the Examiner’s rejection that

²⁶ Figure 3, which MIT also cites, does not show any intervening circuitry or processes between “said map database” and any of the “location system,” “route finder,” or “discourse generator.” Figure 3 does not show any other relevant components.

claim 1 failed to recite the particular connection/interaction of the system components. *See* Harman's Opening Brief at 34-39 (Sec. V.D.2.).

E. “functionally connected”

Harman's Proposed Construction: “connected in a way that facilitates transmission of information; this need not be a physical connection.”

MIT's Proposed Construction: “connected in a way that facilitates transmission of information where said transmission of information may be bidirectional between system components; this need not be a direct physical connection.”²⁷

MIT *again* misrepresents Harman's position with respect to the construction of “functionally connected.” Contrary to MIT's brief, Harman proposes only one construction of the term “functionally connected,” and that construction applies consistently for every instance of the term. MIT Br. at 26. Harman also does not agree with MIT's proposed construction of “functionally connected” in any instance, as MIT misstates in its brief. MIT Br. at 26, 29.

Harman's proposed construction for “functionally connected,” is “connected in a way that facilitates transmission of information; this need not be a physical connection.” This allows the phrase to be used consistently throughout claim 1. Because language in claim 1 *other than* “functionally connected” addresses the directionality and directness of the interaction among the components, Harman's construction of “functionally connected” is rightfully silent as to that directionality and directness. It is MIT's construction of “functionally connected” that dictates bi-directionality and lack of directness for every instance of the phrase in claim 1 that creates havoc and internal inconsistency within claim 1 as a whole.

As explained in Harman's opening brief, MIT added the phrase “functionally connected” as part of an amendment to overcome the Patent Office's rejection of all claims for failure to

²⁷ The differences between the parties' constructions are underlined in MIT's proposed construction.

recite any connectivity/interactivity among the system components. MIT's amendment was required to "enable[] one to understand the manner in which these elements are to interact with one another." *See* Ex. P at 97. MIT's amendment must be taken into account during claim construction. *See Ventana Med. Sys., Inc. v. Biogenex Labs., Inc.*, 473 F.3d 1173, 1182 (Fed. Cir. 2006) ("the prosecution history can often inform the meaning of the claim language by demonstrating how the inventor understood the invention and whether the inventor limited the invention in the course of prosecution" (citing *Phillips*, 415 F.3d at 1317)). Through MIT's amendment, some limitations in claim 1 explicitly claim a particular directionality and/or directness whereas others do not. Harman's construction of "functionally connected" remains true to this fact.²⁸

The phrase "functionally connected" introduces connectivity into claim 1, but does not itself address the issue of directionality or directness. Certain limitations in claim 1 specifically claim a particular directionality of data flow or communication, and other limitations specifically require an interaction that involves one component "consulting" another, accepting something from another, and/or providing something to another. Where, as here, explicit language elsewhere in the claim specifies a directionality or requires a particular interaction, it would be improper to eliminate those expressly-required features through a contrived interpretation of "functionally connected." *See, e.g., Phillips*, 415 F.3d at 1314 ("the claims themselves provide substantial guidance as to the meaning of particular claim terms"). This would be true even if the Patent Office had not forced MIT to amend its claims to add the express requirements MIT now seeks to eliminate.

²⁸ By its own admission, MIT seeks to utilize the term "functionally connected" as a vehicle to broaden the entirety of claim 1 so as to read out all of the other limitations MIT added during prosecution by way of amendment to overcome the Patent Office's rejection. *See* MIT Br. at 29.

MIT's proposed construction of "functionally connected," ignores all of the specifically recited (and therefore, required) connectivity/interactivity in claim 1 by blindly addressing such connectivity/interactivity, out of its proper context, within its sweeping construction of the 2-word phrase. Harman's construction, on the other hand, is correctly silent as to directionality and directness, leaving those requirements to be properly determined by other express language in claim 1. The Court should therefore adopt Harman's construction.

F. "computing apparatus"

The parties do not dispute the *construction* of the "computing apparatus" limitation in claim 1. Both parties agreed, in writing, that (1) there are no issues with respect to the construction of this limitation, (2) the limitation need not be construed by the Court; and (3) that the limitation should be read with its plain and ordinary meaning. *See* Ex. E.²⁹ In its brief, MIT has identified and addressed a potential *infringement* dispute, and attempts to characterize it as a claim construction issue. Harman's position, for purposes of an infringement analysis, is that the claim limitation requires that the "computing apparatus" actually be the apparatus for performing the functions recited throughout the claim.³⁰ Harman does not contend that any particular type or generation of computer is required. There is no dispute that "computing apparatus" need not be construed, and that it simply has its plain and ordinary meaning. For purposes of claim

²⁹ On March 7, 2007, Harman's counsel traveled to Boston to meet and confer with MIT's counsel to discuss and narrow the issues concerning claim construction. After that, the parties continued to meet and confer until on March 19-20, 2007, when Harman memorialized (with MIT's consent) the parties' agreement concerning the issues that would be submitted to the Court. The agreed list of terms to be presented to the court for construction does not include the "computing apparatus" limitation. Ex. E.

³⁰ In other words, for example, the "computing apparatus" (1) must be "for running and coordinating system processes," (2) must be "functionally connected to" the driver input means, which is "for entering data *into said computing apparatus*, said data including a desired destination," and (3) must be "functionally connected to" the position sensing apparatus, which is "for providing *said computing apparatus* data for determining the automobile's current position." There is a non-infringement issue as to what, precisely, may or may not allegedly be providing any such functionality in the complex, advanced systems designed by Harman, but this is not a claim construction issue.

construction, that is all that is relevant. Whether the properly-construed claims do or do not cover any accused Harman device is an issue for a later day.

G. “speech generator”

The parties also do not dispute the construction of the “speech generator” limitation in claim 1. In a continued effort to meet and confer and narrow the issues for the Court, Harman continued exploring possible agreements on the disputed terms. On March 30, in light of Harman’s further consideration of the asserted claims and other issues in this case, Harman advised MIT that it did not believe the “speech generator” limitation required construction, and that Harman would not be challenging MIT’s proposed construction. MIT accepted Harman’s compromise. Ex. QQ. MIT nonetheless inexplicably and unnecessarily briefed the issue of construction for this limitation.

MIT’s brief prematurely raises an infringement dispute, namely, whether any of the accused Harman systems include the “speech generator” limitation under the parties’ stipulated construction, which Harman will address at the appropriate time, within the context of a future resolution of infringement issues.

IV. THE PROPER CONSTRUCTION OF CLAIM 45.

The sole issue with respect to claim 45 relates to the phrase “at the time the act is to be performed.”

Harman’s Proposed Construction: “at the time the act is to be performed” should be given its plain and ordinary meaning (no construction needed)

MIT’s Proposed Construction: ““at the time the act is to be performed” describes relative timing of the short description in reference to the driving act and the long description. This phrase does not require the short description to be given at the instant the act should be performed. Instead, the short description can occur in, on, or near the location on the route at which the act is to be performed or shortly before the driver is required to act.”

Harman believes the disputed phrase, which contains no technical terms or terms of art, is perfectly capable of being understood by — and applied by — a jury without further guidance from the Court. Indeed, any attempt to further clarify the plain language of claim 45 would impermissibly alter the literal scope of claim 45.

A. “at the time the act is to be performed”

1. This simple phrase should be given its plain and ordinary meaning.

First, and foremost, the phrase “at the time the act is to be performed” need not be construed by the Court. To read unnecessary language into this phrase would only confuse otherwise simple matters, and would be improper. *See U.S. Surgical Corp. v. Ethicon, Inc.*, 103 F.3d 1554, 1568 (Fed. Cir. 1997) (claim construction required only “when the meaning or scope of technical terms and words of art is unclear and in dispute and requires resolution”); *Brown v. 3M*, 265 F.3d 1349, 1352 (Fed. Cir. 2001). Any attempt by MIT to read additional language into this phrase constitutes misrepresentation of the scope of claim 45 itself, the alleged invention, and quite simply, the facts.

The entirety of claim 45 reads:

- 45. The automobile navigation system of claim 1 wherein said discourse generated comprises:
 - [1] a long description of an act given *substantially before* the act is to be performed and
 - [2] a short description given *at the time* the act is to be performed.

Ex. F at claim 45 (emphasis and reference numerals added for clarity).

The claim requires both [1] a long and [2] a short description, and each has its own qualifier that describes *when* the instruction is given. Notably, the timing of the long description (“substantially before the act is to be performed”) is not disputed, and MIT agrees it need not be

construed. *See* Ex. E at 4. Thus, MIT concedes that a jury can understand the 8-word phrase “*substantially before* the act is to be performed” in claim 45. However, immediately thereafter, when the same claim uses nearly the exact same phrase (6 of the same 8 words) to describe the timing of the “short description” (“*at the time* the act is to be performed”), MIT contends a jury needs a 68-word “clarification” in order to understand that phrase. If anything, “at the time” is even easier for a jury to understanding than “substantially before.” In any event, neither phrase needs to be construed.

2. Harman’s construction is consistent with the descriptions of the Back Seat Driver in operation; MIT’s construction is not.

In 1990, while the ’685 patent was being prosecuted in the Patent Office, MIT made a promotional video for the Back Seat Driver. *See* Ex. RR (filed under separate cover). The video shows two examples of turns that employ directions like those recited in claim 45:

- First, beginning at 01:06 on the video, the system provides a “long description of an act given substantially before the act is to be performed (“bear right at the stop sign”). Then, at 1:15 on the video, the system follows with “a short description given at the time the act is to be performed (“bear right”). The short description is given after the driver stops at the stop sign, and as he begins to make the turn.
- Second, beginning at 01:33 on the video, the system provides a “long description of an act given substantially before the act is to be performed (“get in the right lane...”). Then, at 1:41 on the video, the vehicle is shown stopped at an intersection, and the system follows with “a short description given at the time the act is to be performed (“here’s the turn”). The short description is given after the driver stops at the intersection, just as he is to begin making the turn.

The video is properly considered as evidence of the correct construction of claim 45, as it further supports the meaning dictated by the intrinsic evidence. *See Global Maintech Corp. v. I/O Concepts, Inc.*, 179 Fed. Appx. 47, 51-52 (Fed. Cir. 2006) (affirming the lower court’s reliance on the extrinsic evidence to support the claim construction reached by the intrinsic evidence). Harman’s construction remains true to this evidence. MIT’s does not.

3. Harman’s proposed construction of claim 45 does not require abrupt or unsafe acts.

MIT again misrepresents Harman’s proposed construction; this time by asserting that Harman requires the navigation system to “abruptly inform the driver that a maneuver is immediately required and not before.” MIT Br. at 41. This is not true. MIT’s argument ignores the rest of the language in claim 45. Claim 45 requires two instructions — both “a long description of an act given substantially before the act is to be performed” **and** “a short description given at the time the act is to be performed.” The use of two descriptions eliminates any abrupt surprises or unsafe directions.

Indeed, the specification teaches that the long description is used to give advance notice in order to avoid surprise, while the short description is used to precisely identify the exact location of the act, so as to avoid vagueness, potential confusion, or a premature turn when streets are grouped closely together. That is why the short description is given “at the time the act is to be performed” and not any earlier. *See* Ex. F at Col. 2 Lns. 44-48 (instructions given “**just in time**...to take the required action, and thus the driver need not remember the instruction or exert effort looking for the place to act”), Col. 11 Lns. 36-37 (“[a]n action described too soon may be forgotten.”)

Even MIT acknowledges the “early notice” purpose of the **long** description; but then misrepresents the cited passage, as if it relates solely to the **short** description. MIT Br. at 41. Specifically, MIT cites to column 16, line 41 for support that “[m]ost often the time at which the **short description** begins will be less than ‘**a few seconds**’ **before** the action is to occur.” MIT Br. at 41 (emphasis added). However, column 16, line 41 does not refer to the short description; it refers to the long one:

When an act is **more than a few seconds in the future**, The Back Seat Driver uses a **long description**, which includes one or more cues which either describe the

place for the act, the features of the road between the current location and the place, or the distance or time until the act. This description should be so clear that the driver cannot only recognize the place when it comes, but can also be confident in advance that she will be able to recognize the place.

Ex. F at Col. 16 Lns. 41-46 (emphasis added).

Continuing its deception, MIT then includes a block quote of column 16, lines 33-40, to support its argument that “[t]he patent specification indicates that the instruction should be provided before the instant the driver is required to act.” MIT Br. at 41 (MIT’s emphasis). Notably, MIT’s argument ambiguously refers to “the instruction,” in order to avoid revealing that the cited passage refers to the **long** description being provided “before” the time the driver is required to act. However, the cited passage from the specification is not ambiguous; it notes that it refers to the first, **long description** being given “a few seconds” before the act, not the second, **short description**, which is described as being given “at the moment to act,” and which must be “obeyed at once”:

Besides telling drivers what to do, the Back Seat Driver must also tell them when to do it. One way to do this is by **speaking at the moment to act**, but it is useful **to also give** instructions before the act, if time permits. This allows time for preparation, if required, permits the driver to hear the instruction **twice**, and also spares the driver the need to be constantly alert for a command which **must be obeyed at once**.

Ex. F at Col. 16. Lns. 33-40 (emphasis added).

When an act is **more than a few seconds in the future**, The Back Seat Driver uses a **long description**, which includes one or more cues which either describe the place for the act, the features of the road between the current location and the place, or the distance or time until the act. This description should be so clear that the driver cannot only recognize the place when it comes, but can also be confident in advance that she will be able to recognize the place.

Ex. F at Col. 16 Lns. 41-46 (emphasis added).

MIT cannot avoid the clear language of claim 45 or the specification of the patent by confusing the difference between the long and short descriptions.

4. MIT's proposed construction is fatally vague, and would further render claim 45 indefinite (and thus invalid under § 112) were it adopted.

Section 112, Paragraph 2 of the Patent Act requires that

[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

35 U.S.C § 112 ¶ 2. This section is known as the definiteness requirement. “If the court determines that a claim is not ‘amenable to construction,’ then the claim is invalid as indefinite...” *Novo Indus., L.P. v. Micro Molds Corp.*, 350 F.3d 1348, 1353 (Fed. Cir. 2003); *Bancorp Svcs., LLC v. Hartford Life Ins. Co.*, 359 F.3d 1367, 1371 (Fed. Cir. 2004) (noting that the court determines as a matter of law whether a patent claim is invalid for failure to meet the definiteness requirement); *see also Competitive Techs., Inc. v. Fujitsu Ltd.*, 185 Fed. Appx. 958, 965-66 (Fed. Cir. 2006) (finding that claims which included the term “address means” were indefinite, and thus invalid, where the potential meaning was inconsistent with additional claim terms); *Datamize, LLC v. Plumtree Software, Inc.*, 417 F.3d 1342, 1352 (Fed. Cir. 2005) (finding a claim invalid based upon the indefiniteness of the phrase “aesthetically pleasing” because the definition of a claim term “cannot depend on the undefined views of unnamed persons...”)

The public policy rationale for the definiteness requirement is “to ensure that the claims are written in such a way [] that interested members of the public [] can determine whether or not they infringe.” *Invitrogen Corp. v. Biocrest Mfg. L.P.*, 424 F.3d 1374, 1384 (Fed. Cir. 2005) (citing *Oakley, Inc. v. Sunglass Hut Int’l*, 316 F.3d 1331, 1340 (Fed. Cir. 2003)); *see also Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1560 (Fed. Cir. 1991) (noting that the policy rationale was to “shape[] the future conduct of persons other than the inventor, by insisting that they receive notice of the scope of the patented device.”) Thus, the Federal Circuit has noted that “to sustain claims so indefinite as not to give the notice required by the statute would be in direct

contravention of the public interest which Congress therein recognized and sought to protect.” *Wilson Sporting Goods*, 422 F.3d at 1330 (citing *United Carbon Co. v. Binney & Smith Co.*, 317 U.S. 228, 233 (1942)).

Although indefiniteness is an issue of validity, it can play a key role in claim construction, as well, since the Court must avoid introducing indefiniteness into an otherwise definite claim through the process of claim construction. *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1384 (Fed. Cir. 2001) (“Claims amenable to more than one construction should, when it is reasonably possible to do so, be construed to preserve their validity.”); accord *Turbocare Div. of Demag Delaval Turbomach. Corp. v. Gen. Elec. Co.*, 214 F. Supp. 2d 170, 180 (D. Mass. 2002). The Patent Office allowed claim 45 on the condition that a short description of an act be given to the driver “at the time the act is to be performed.” The Patent Office would never have allowed a version of claim 45 that was written using the words found in MIT’s proposed construction, which do not satisfy the definiteness requirement of § 112, ¶ 2. As such, it is improper to re-write the claim in such a way during claim construction. *See, e.g., Geneva Pharms., Inc. v. GlaxoSmithKline PLC*, 349 F.3d 1373, 1385 (Fed. Cir. 2003) (rejecting a proposed construction because “[t]his reading of the claim is indefinite.”)

Specifically, MIT’s proposed construction is impermissibly vague and indefinite because:

- By construing the phrase to describe “relative timing” which MIT asserts means enough time for the “driver to safely hear the instruction and react to it,” (*see* MIT Br. at 40) MIT’s proposed construction depends upon (and varies with) the person driving, their reaction time, their eyesight, their familiarity with the area (are they new to Boston?), their attentiveness (are they on a cell phone?), how fast they are driving, the weather (are the roads slick? or icy?), the time of day (is it dark?), the conditions (are there streetlights?) and the condition of vehicle (are the tires properly inflated? worn out? Is the steering within specification? Is the suspension a “sport suspension” that can handle turns in a safer manner?). For some drivers, conditions, or vehicles, this may be a few moments; for others it may be a few or several seconds.

- By replacing “at the time” with “in, on, or near the location on the route at which,” MIT’s proposed construction not only eliminates an express temporal requirement recited in the claim, but also introduces a new question for the jury to decide — how near is near enough to literally fall within claim 45? Thus, rather than help the jury understand claim 45, MIT’s construction just adds confusion and ambiguity.
- By including the phrase “shortly before the driver is required to act,” MIT’s proposed construction adds another level of ambiguity – how “shortly before” is sufficiently “shortly before” to be literally within the claim? Also, the phrase “driver required to act” is ambiguous and can vary among drivers, conditions, and vehicles.

MIT’s proposed construction is designed to broaden the literal scope of claim 45 to cover just about any type of instructions given at just about any time (for purposes of infringement), but then deny that the prior art teaches the alleged invention (for purposes of validity). That is not what is claimed, and such lack of precision violates § 112 ¶ 2.

5. MIT’s construction is a premature attempt at an equivalency infringement argument.

It bears repeating that this is claim construction, not infringement analysis. The disputed language of claim 45 is not unclear, and it requires the short description to be given “at the time the act is to be performed,” not some other time. MIT obviously wants to argue that spoken instructions that are given at some point in time earlier than “at the time the act is to be performed” are covered by claim 45 under the Doctrine of Equivalents. However, claim construction is not the proper time for the Court to analyze any equivalency arguments, or to broaden the literal scope of the claim. The availability and applicability of an equivalency argument can only take place once the literal scope of the limitation has been determined. Here, the literal scope of claim 45 is easy. The phrase need not be construed, and the jury need only be told to give the phrase its plain and ordinary meaning of “at the time the act is to be performed.”

V. CONCLUSION.

For these reasons, Harman respectfully requests that this Court adopt Harman's proposed constructions for the disputed terms of the '685 patent.

Dated: April 20, 2007

Respectfully submitted,

/s/ Courtney A. Clark
Robert J. Muldoon, Jr., BBO# 359480
Courtney A. Clark, BBO# 651381
SHERIN AND LODGEN, LLP
101 Federal Street
Boston, MA 02110
(617) 646-2000 (phone)
(617) 646-2222 (fax)

William A. Streff Jr., P.C.
Craig D. Leavell
Michelle A. H. Francis
Jamal M. Edwards
Colleen Garlington
Joanna Belle Gunderson
KIRKLAND & ELLIS LLP
200 East Randolph Drive
Chicago, IL 60601
(312) 861-2000 (phone)
(312) 861-2200 (fax)
Attorneys for Defendant

CERTIFICATE OF SERVICE

I hereby certify that this document filed through the ECF system will be sent electronically to the registered participants as identified on the Notice of Electronic Filing and paper copies will be sent to those indicated as non-registered participants on April 20, 2007.

/s/ Courtney A. Clark
Courtney A. Clark

Exhibit

DD

Excerpts from:

Patent Classification Definitions

Class 340 - Communications, Electrical

June 1990

Harman will provide the entirety of this
document at the Court's request

U.S. PATENT AND TRADEMARK OFFICE

DOCUMENTATION ORGANIZATIONS



PATENT CLASSIFICATION DEFINITIONS

CLASS 340 - COMMUNICATIONS, ELECTRICAL

June 1990

The information contained herein is current through the date shown above.

340-92

CLASSIFICATION DEFINITIONS

June 1990

978. **Speed:**
Subject matter under subclass 971 having an indicator representing the velocity of the aircraft relative to the surrounding air or to ground.

979. **Heading (Includes Deviation From Desired Course):**
Subject matter under subclass 971 having an indicator representing the position or direction of the aircraft with respect to a desired course or course direction.

980. **Indicator Visible in Pilot's Line of Sight Through Windscreen:**
Subject matter under subclass 971 wherein the pilot can observe the indicator while his line of sight is through the windscreen or windshield.

981. **Aircraft Beacons:**
Subject matter under subclass 945 having beacons on-board the aircraft perceptible by an observer remote from the aircraft.

SEARCH CLASS:

362. Illumination, subclass 62 for aircraft light structure.

982. **Lights Communicate (e.g., Direction, Altitude, Reference Position to Observer):**
Subject matter under subclass 981 wherein the beacons are visual signals which indicate to the observer information concerning the flight path or position of the aircraft.

(1) Note. For example, this information may be the direction, altitude, reference position etc., of the aircraft to the observer.

983. **Obstruction Beacon:**
Subject matter under subclass 945 having a beacon at the location of an object to warn aircraft of the presence of that object.

984. **WATERCRAFT ALARM OR INDICATING SYSTEMS:**
Subject matter under the class definition having alarms or indicators particular to boats or other aquatic type vehicles.

SEARCH CLASS:

114. Ships, for related subject matter.

985. **Navigation Guides (e.g., Channel Lights):**
Subject matter under subclass 984 having means to direct a watercraft to a particular location.

(1) Note. Included are channel or harbor lights when used for guidance.

SEARCH THIS CLASS, SUBCLASS:

947. for similar systems when used to guide aircraft.

986. **Anchor Movement:**
Subject matter under subclass 984 having an alarm actuated upon movement of a device which holds the watercraft in place.

987. **Rudder Position Indicator:**
Subject matter under subclass 984 having an indicator showing the position of the movable element hinged at the stern of the boat and used for steering.

988. **VEHICLE POSITION INDICATION:**
Subject matter under the class definition having means to indicate the position or location of a vehicle.

SEARCH THIS CLASS, SUBCLASS:

901. for electrical condition vehicle-mounted indicator or alarm.

933. for vehicle detectors.

989. **At Remote Location:**
Subject matter under subclass 988 wherein the indication is developed at a location remote from the vehicle.

990. **With Map Display:**
Subject matter under subclass 989 wherein the remote location includes a map with the location of the vehicle indicated on the map.

SEARCH THIS CLASS, SUBCLASS:

286. for nonvehicle map display.

995. for map located on the vehicle.

991. **Position Indications Transmitted by Vehicle after Receipt of Information from Local Station:**
Subject matter under subclass 989 wherein the vehicle receives its location indication from a local station in its vicinity, then transmits that location indication to a remote station.

June 1990

CLASSIFICATION DEFINITIONS

340-93

992. Position Indication Transmitted at Periodic Intervals (e.g., Distance Travelled):
Subject matter under subclass 989 wherein the position indication is transmitted to the remote station periodically (e.g., the distance travelled by the vehicle defining the periodic interval).

993. Position Indication Transmitted by Local Station to Remote Location:
Subject matter under subclass 989 wherein a local station in the vicinity of the vehicle detects the vehicle and transmits the position indication of the vehicle to a remote station.

994. Vehicle's Arrival or Expected Arrival at Remote Location Along Route Indicated at That Remote Location (e.g., Bus Arrival Systems):
Subject matter under subclass 989 wherein an indicator at a remote location indicates when a vehicle is expected to arrive at that remote location.

995. Map Display:
Subject matter under subclass 988 including a map with the location of the vehicle indicated on the map.

SEARCH THIS CLASS, SUBCLASS:

990. for the map located at a remote location.

996. Prerecorded Message Describes Position:
Subject matter under subclass 988 wherein the indication includes a prerecorded message describing the position of the vehicle.

SEARCH CLASS:

360. Dynamic Magnetic Information Storage or Retrieval, subclass 12 for magnetic recording or reproducing for automatic announcing.

END

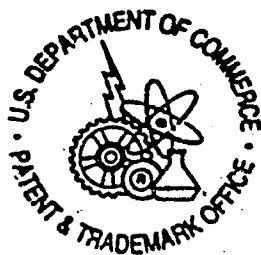
Excerpts from:

Patent Classification Definitions

Class 364 - Electrical Computers and Data
Processing Systems

June 1990

Harman will provide the entirety of this
document at the Court's request

U.S. PATENT AND TRADEMARK OFFICE**DOCUMENTATION ORGANIZATIONS****PATENT CLASSIFICATION DEFINITIONS****CLASS 364 - ELECTRICAL COMPUTERS AND
DATA PROCESSING SYSTEMS****June 1990**

The information contained herein is current through the date shown above.

June 1990

CLASSIFICATION DEFINITIONS

364-51

431.10 Starting, Warmup:

Subject matter under subclass 431.04 wherein the engine starting condition is sensed or engine warmup is controlled.

SEARCH CLASS:

123, Internal-Combustion Engines, subclasses 424 and 491 for the starting or cold running condition of an engine.

431.11 Backup, Interrupt, Reset or Test:

Subject matter under subclass 431.04 including specific structure of a digital means which is either a backup, interruption, reset or test circuit.

SEARCH CLASS:

123, Internal-Combustion Engines, subclass 479 for backup systems.

371, Error Detection/Correction and Fault Detection/Recovery, subclass 16 for general testing of programmable digital data systems.

431.12 Specific Memory or Interfacing Device:

Subject matter under subclass 431.04 including specific structure of a digital means which is either a memory or an interfacing device.

SEARCH THIS CLASS, SUBCLASS:

900, for miscellaneous digital data processing systems which may include interfacing structure.

SEARCH CLASS:

365, Static Information Storage and Retrieval, appropriate subclasses for memory devices.

432. With Indication or Control to Maintain Fixed Position:

Subject matter under subclass 424 wherein a particular fixed position of a vehicle with respect to a particular reference is maintained.

433. With Indication or Control of Altitude/Depth or Rate of Ascent or Descent:

Subject matter under subclass 424 wherein the area includes the height or depth of a vehicle or the velocity of ascent or descent.

(1) Note, subclass 428 takes precedence.

434. With Indication or Control of Vehicle Attitude: Subject matter under subclass 424 wherein a particular attitude of the vehicle in relation to a given line or plane, such as the horizon, is maintained.

435. Angle of Attack: Subject matter under subclass 434 wherein the attitude of the vehicle is the acute angle between the chord of an airfoil and the line of relative air flow or horizontal.

436. Traffic Analysis or Control of Surface Vehicle: Subject matter under subclass 424 wherein the area includes the organized movement of surface vehicles.

SEARCH CLASS:

340, Communications, Electrical, subclasses 984+ and 47 respectively, for nautical and railroad vehicles, and subclasses 933+ for vehicles which are controlled by traffic conditions.

437. With Determination of Traffic Density: Subject matter under subclass 436 which includes a determination of the number of vehicles per unit of time that pass a particular point.

438. With Determination of Traffic Speed: Subject matter under subclass 436 which includes a determination of a distance travelled per unit time for the traffic.

439. Traffic Analysis or Control of Aircraft: Subject matter under subclass 424 wherein the area includes the organized movement of aircraft along particular routes.

SEARCH CLASS:

340, Communications, Electrical, subclass 951 for airport control systems which do not include data processing techniques.

440. With Speed Control or Order: Subject matter under subclass 439 which includes a determination of or control of the speed of an aircraft.

441. With Course Diversion: Subject matter under subclass 439 which includes commanding or indicating departure from prior course.

364-52

CLASSIFICATION DEFINITIONS

June 1990

442. With Indication of Fuel Consumption Rate or Economy of Usage:

Subject matter under subclass 424 which includes determining or indicating amount of fuel consumed per unit time or most economical fuel consumption or distance available for a given amount of fuel.

443. Navigation:

Subject matter under subclass 400 wherein course, position or distance travelled is determined.

SEARCH CLASS:

33. Geometrical Instruments, appropriate subclasses, particularly subclasses 300+ for celestial navigational instruments.

73. Measuring and Testing, subclasses 178+ for instruments used in conducting a craft through a fluid medium, and subclass 178 for navigation.

244. Aeronautics, subclass 3.18 for celestial navigation.

342. Communications, Directive Radio Wave Systems and Devices (e.g., Radar, Radio Navigation), subclasses 385+ for radio wave energy for direction finding receivers; and subclasses 1 - 205 for radar navigation systems (n.b.: Class 364 includes radar navigational computation, per se, and Class 342 type radar navigational computation includes structure to a radar device.).

356. Optics, Measuring, and Testing, subclass 3 for optical range finders, and subclasses 27+ for velocity or height measuring.

434. Education and Demonstration, subclasses 111, 186, and 239+ relating to training or instructions in the area of navigation; subclass 1 for training in the use of radar or sonar detecting or range finding and subclasses 30+ for aircraft training, per se.

444. Determination of Course or Distance From Present Position to Destination:

Subject matter under subclass 443 where course or distance from a present position to a destination is determined.

445. Great Circle Route:

Subject matter under subclass 444 where the course lies along the shortest line between two points on the surface of a sphere.

446. Determination of E.T.A.:

Subject matter under subclass 443 where the time of arrival at a destination is determined.

447. Determination of Along-Track or Cross-Track Deviations:

Subject matter under subclass 443 where the deviation of a present position from a desired position in a direction parallel to or perpendicular to the course is determined.

448. Employing Way Point Navigation:

Subject matter under subclass 443 where the position relative to an intermediate point between origin and destination is determined.

449. Employing Position-Determining Equipment:

Subject matter under subclass 443 using equipment which determines position.

450. Using Dead-Reckoning Apparatus:

Subject matter under 449 wherein position is determined from course and distance made from the last known position and known or estimated drift.

451. Using R-O (D.M.E. and Path) or Tacan Equipment:

Subject matter under 449 having either Tacan, or distance and bearing measuring equipment.

452. Using Loran or Shoran or Decca Equipment:

Subject matter under 449 where position is determined from hyperbolic lines of position.

453. Using Inertial Sensor:

Subject matter under 449 where there is means to sense a force caused by acceleration.

454. With Correction by Noninertial Sensor:

Subject matter under subclass 453 with correction by sensing a noninertial property.

Filed Under Seal

Exhibit

EE

Exhibit

FF

(12) UK Patent Application (19) GB (11) 2 079 453 A

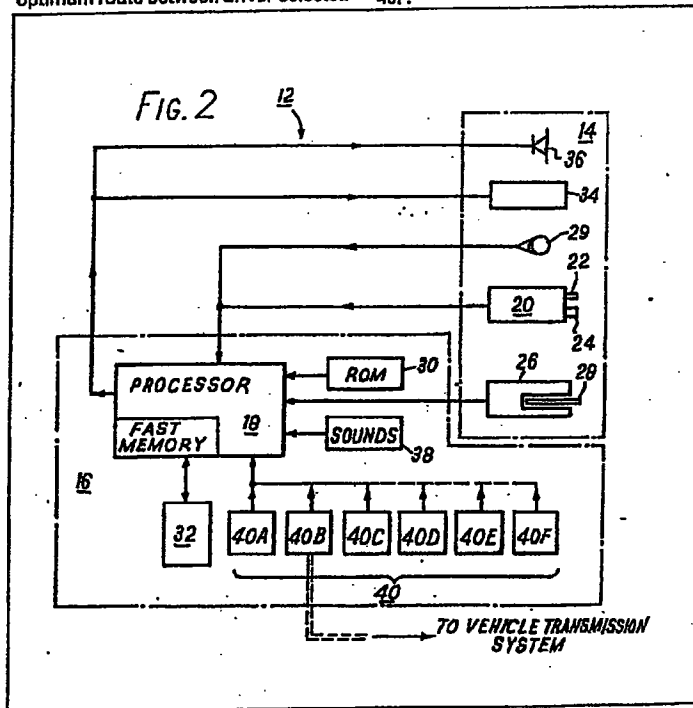
- (21) Application No 8021522
 (22) Date of filing 1 Jul 1980
 (43) Application published
 20 Jan 1982
 (51) INT CL³
 G01C 21/00
 (52) Domestic classification
 G1F 1H
 (56) Documents cited
 GB 2013890A
 GB 2013018A
 GB 1414490
 GB 1227531
 GB 1209852
 GB 1206894
 GB 1113522
 (58) Field of search
 G1F
 G5R
 (71) Applicants
 Harold John Wootton,
 12 Milburn Walk,
 Epsom,
 Surrey KT18 5HN.
 (72) Inventors
 Harold John Wootton
 (74) Agents
 Saunders & Dolleymore,
 2a Main Avenue,
 Moor Park,
 Northwood,
 Middx. HA8 2HJ.

(54) Route selection and guidance apparatus and method

(57) Route selection and guidance apparatus for a vehicle includes a digital data processor 18 controlled by programs stored in a ROM 30 to select an optimum route between driver-selected

journey starting and finishing positions, using driver-selected optimisation criteria. Map data is stored in a storage unit 32, entered manually or verbally by a driver-operable entry module 26. The selected route is stored in the storage unit 32, and serves to provide with an instruction during each route-stage, each instruction being announced to the driver when a vehicle-position feedback signal from a feedback device 40 corresponds with a position reference signal contained in the instruction. Additional signals may be included to cancel an announced instruction and replace it by the next when the position feedback signal corresponds to the additional reference signal.

Instructions are announced vocally 38 or visually 34. Position feedback signals are derived directly or indirectly from position feedback devices 40, which may give output signals dependent upon elapsed-time 40A, distance travelled 40B, or actual vehicle position 40C-40F.



GB 2 079 453 A

MIT 03570

2079453

1/1

FIG. 1

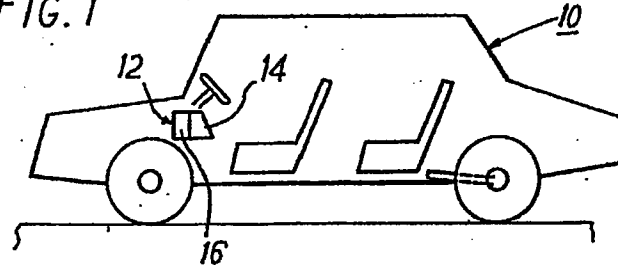
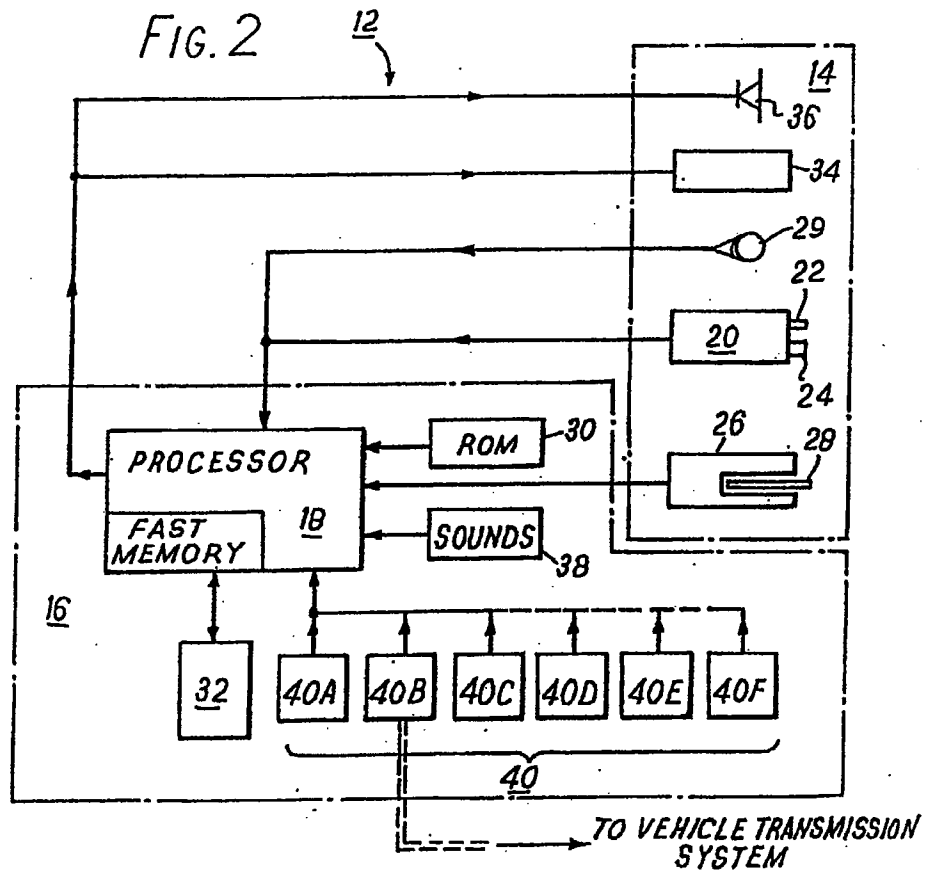


FIG. 2



MIT 03571

SPECIFICATION

Route selection and guidance apparatus and method

- 5 This invention relates to an apparatus and method for providing a driver of a driver-controlled vehicle with information identifying successive sections of a route to be followed, so as to enable the vehicle to be driven from a selected starting point to a selected finishing point. In the specification the term "vehicle" is intended to cover any form of moving craft the route of which over land or sea, or in the air, is dependent on a driver or pilot action to direct the craft along successive sections of a selected route. 5
- 10 Though in the description that follows the invention will be described in relation to the driving of a land vehicle along roads, the invention may also be applied to the navigation of boats along waterways or across the open sea, and also to the piloting of an air-craft through the sky. 10
- It has been shown recently by transport planning authorities that in the United Kingdom the distance travelled by all vehicles in getting to their destinations is some 6 per cent greater than that which was actually necessary for the performance of the required journeys. Such an over-travel represents a loss to the United Kingdom economy of some 1500 million pounds. Hence, a means for enabling this over-travel to be reduced would be a substantial benefit to those who make the journeys, and to the UK economy. 15
- The basic source of route information for the modern road vehicle driver has been traditionally the printed map, and from that the driver (or some one acting for him) has determined, according to his own intuitive criteria, and his own personal assessment of factors such as road conditions and congestion, the route that he should follow in making any particular journey. 20
- Thus, the preliminaries to a road journey included the making of an analysis and an assessment of the possible alternative routes between the starting and finishing positions, and a selection of the route to be followed, and possibly the writing down of that route for subsequent reference during the journey. This involved some considerable time and effort, and for best results an up-to-date knowledge of the geography and traffic conditions prevailing on the various route sections shown on the map. 25
- For the private motorist, particularly, this problem of route selection has been aided by the professional motoring organisations, which have provided on request special printed route maps complete with accompanying written instructions for the guidance of the driver or navigator during the course of the journey. Unfortunately, such route maps and instructions usually required the making of a specific request some days before the intended departure on the journey, so that the relevant route could be selected and the relevant map sections and instructions compiled for despatch to the intending traveller. 30
- Furthermore, the following of such a set of route instructions required the driver or navigator to be ever attentive as to his exact position on the route map and instruction set, so that he could anticipate his arrival at the next mentioned cross-roads or turning. Moreover it was necessary for him to constantly memorize the next guidance instruction appertaining to the next route section. 35
- Though such special route maps and guidance instruction sets were of great benefit to the motorist, they had the disadvantage of involving another party in the selection and preparation of a route and also that once prepared the driver could not expeditiously or easily modify the map and guidance instruction set to deal with unforeseen conditions or events such as for example traffic diversions or adverse road conditions due for example to accidents or weather. 40
- According to a first aspect of the present invention there is provided in or for a vehicle (as hereinbefore defined), a route guidance apparatus comprising:-
- (a) *instruction producing means* for producing in sequence from a pre-planned route individual route-stage instructions each defining an action to be taken by a driver of a vehicle at the end of an associated route-stage, each such instruction including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him; 45
- (b) *feedback signal producing means* for producing feed back signals representative of the progress of the vehicle along the route-stage, each such feedback signal being representative directly or indirectly of the position of the vehicle on said route-stage; 50
- (c) *instruction announcing means* for announcing to the driver, on its being activated, a said instruction represented by output signals of the instruction producing means;
- (d) *signal comparison means* for comparing during each said route-stage said reference and feedback signals and for activating said instruction announcing means when said reference and feedback signals correspond, thereby to announce to the driver the instruction associated with the said reference signal, and 55
- (e) *activating means* for activating said instruction producing means thereby to cause it to produce the next route-stage instruction in the sequence in place of a current one.
- Said activating means may be driver-operable; though in a preferred apparatus each route-stage instruction produced by said instruction producing means also includes an additional reference signal which represents the intended vehicle position at the end of the associated route-stage, at which position the driver should act on that instruction; and there is included comparison means for comparing during each route-stage said feedback and additional reference signals and for stimulating said activating means when said feedback and additional reference signals correspond, thereby to cause said instruction producing means to produce the next route-stage instruction in the sequence in place of the current one. 60 65

2 GB 2 079 453 A

2

In one form of guidance apparatus according to the present invention said instruction producing means is arranged to store a plurality of sets of route-stage instructions for enabling a driver to be guided along various routes respectively; and said instruction producing means includes driver-operable route selection means for enabling a driver to select from said various routes a specific one along which he wishes to be
 5 guided, said instruction producing means being operative on selection of route to produce in sequence and as required by said activating means the successive route-stage instructions appertaining to the selected route.

Advantageously said route selection means includes driver-operable selection means for identifying the starting and finishing positions of a journey for which guidance is required, and means for automatically
 10 selecting from said plurality of sets of route-stage instructions the set having the driver-identified starting and finishing positions, thereby to cause the desired set of route-stage instructions to be produced in sequence and as required by said activating means.

In a preferred form of guidance apparatus according to the present invention said instruction producing means includes

15 a route compiling means for compiling each said pre-planned route on being required by a driver, and a driver-operable journey selection means for identifying the starting and finishing positions of a journey for which guidance is required; and
 said route compiling means includes -

(a) a data processing means,
 20 (b) a map data storage means for storing map data defining and describing the respective road sections of a road system on a predetermined map section, each such road section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him,
 (c) a program storage means for storing programs for controlling the operation of the data processing means, and for causing it to carry out, on request and according to a predetermined optimization criterion, a
 25 route evaluation and selection process to determine an optimum route between the driver-identified journey starting and finishing positions on the said map section, and means for storing that optimum route and announcing route-stage instructions appertaining to it in sequence as required by said activating means.

Preferably, said program storage means has stored within it alternative programs, or program modifiers, for enabling the data processing means to carry out on request route evaluation and selection processes
 30 according to any one of a plurality of different optimization criteria, and there is provided driver-operable optimization criterion selection means for selecting for a particular journey to be undertaken the particular optimization criterion or criteria to be used.

Conveniently, said data processing means is also arranged to carry out the functions of the respective comparison means for comparing on the one hand said feedback and reference signals, and on the other
 35 hand said feedback and additional reference signals.

Said map data storage means may have associated therewith map data entry means for receiving removable map data storage elements, whereby data appertaining to any desired area of a map may be entered into said map data storage means for use temporarily by said data processing means.

Vocal input means for receiving a driver's spoken input information identifying a journey to be undertaken
 40 may be provided, and said data processing means may then be arranged to decode that vocal input information and to act upon it in selecting a route for a journey to be undertaken by the driver.

Preferably, said instruction announcing means is arranged to announce each said route-stage instruction in vocal form, and said data processing means is arranged to produce and/or control signals for vocalizing said instructions.

45 Said instruction announcing means may be arranged to announce each route-stage instruction in visual form.

Said feedback signal producing means may take any one of a plurality of different forms; for example, an elapsed-time measuring means arranged to be carried by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependent on the time that has elapsed
 50 since last being activated; or alternatively a distance measuring means arranged to be driven by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependent on the distance travelled by the vehicle along the route-stage since last being activated; or alternatively an inertial-guidance position determining means arranged to be carried by said vehicle and to compute from vehicle motion the position of the vehicle, and to provide an output vehicle-position-
 55 indicating signal dependent on said position for comparison with position indicating signals constituted by said reference and/or said additional reference signals incorporated in said route-stage instructions; or otherwise a vehicle position determining means arranged to be carried by said vehicle and to compute, from bearings of objects disposed externally of the vehicle on or around the earth's surface, the position of the vehicle, and to provide an output vehicle-position-indicating signal for comparison with position-indicating
 60 signals constituted by said reference and/or said additional reference signals incorporated in said route-stage instructions.

Preferably, each said route-stage instruction is represented in electrical signal form, and said reference, additional reference, and feedback signals comprise electrical signals.

According to a second aspect to the present invention a method of guiding a driver of a vehicle (as
 65 hereinbefore defined) along a multi-stage route between journey starting and finishing positions, comprises -

MIT 03573

3

GB 2 079 453 A

3

(a) generating and storing for said route a sequence of individual route-stage instructions each defining an action to be taken by the driver at the end of the associated route-stage, and each including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him;

5 (b) extracting a said instruction that is associated with a first route-stage and holding it ready for announcement to the driver;

(c) generating a feedback signal representative of the progress or position of the vehicle along the route-stage;

(d) comparing said reference and feedback signals,

10 (e) announcing the extracted instruction to the driver when said reference and feedback signals correspond;

(f) indicating when the vehicle has passed into the next route-stage; and

(g) repeating cyclically in turn the steps (b) to (f) above for the second and subsequent instructions in the sequence.

15 Each said route-stage instruction generated in said step (a) above may also include an additional reference signal representing the intended vehicle position at the end of the associated route-stage, at which position the driver should act upon that instruction; and

the step (f) above may then comprise comparing said feedback and additional reference signals and indicating when said feedback and additional reference signals correspond that the vehicle has passed into the next route-stage.

20 Such methods may also include the preliminary step of specifying the starting and finishing positions of a journey for which guidance is required, and the criterion or criteria to be used in selecting an optimum route between those positions, and

25 in the said step (a) said sequence of instructions is obtained by generating from stored map data defining and describing the respective road sections of a road system (each such section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him) the optimum route between the specified starting and finishing positions and based on the specified optimization criterion or criteria, and storing the route-stage instructions for the successive route-stages making up that optimum route.

30 Other features and advantages of the present invention will appear from the description that follows hereafter, and from the claims appended at the end of that description.

One embodiment of the present invention for providing route selection and driver guidance instructions in or for a road vehicle will now be described by way of example and with reference to the accompanying diagrammatic drawings, in which:-

35 *Figure 1* shows in outline a motor car in which a route selection and driver guidance system according to the present invention is installed; and

Figure 2 shows schematically the various components of that system, and the manner of their interconnection.

Referring now to the drawings, a motor car 10 has installed in it a route selection and driver guidance system 12, which includes a drivers' console 14 fitted in a forward position convenient for a driver to operate, observe and hear, and an associated equipment module 16 which is mounted preferably alongside the console, though if required its constituent components could be mounted elsewhere in or around the car.

The system 12 is shown in more detail in *Figure 2*, from which it will be seen to include a digital data processor 18 which is connected to receive input information concerning a route to be determined from

45 (a) a driver's function control and data entry module 20 having "function control" push-buttons 22, and "data entry" keys 24,

(b) a "map data" input module 26 for receiving a magnetic storage element 28 (for example a tape or disc) carrying data defining, describing and qualifying each and all of the road sections (i.e. lengths of road between pairs of adjacent road intersections) included in a particular map section of the United Kingdom road system, and

(c) a driver's microphone 29 for inputting a driver's vocal instructions.

50 Associated with the data processor 18 is a read-only, random-access, memory ("ROM"), in which is stored the operating programs for controlling the operations of the process, and various programs (and program modifiers) for use in the processor for determining alternative routes between driver-specified starting and finishing positions, according to any one or more of a variety of selected overriding criteria, e.g. shortest distance, minimum running time, best fuel consumption, avoidance of urban roads or motorways.

Also associated with the processor 18 is a data storage unit 32 (preferably of the random-access kind) for storing data inputted to it via the processor 18 by the map data input module 26.

60 The output of the processor 18 is transmitted to a driver's visual display unit 34 for providing visual guidance instructions, and/or to a driver's loudspeaker (or earphone) 36 for providing vocal guidance instructions. A vocabulary of sound producing signals (representing various basic phrases, words and syllables) is stored in a sound vocabulary unit 38 for use at appropriate times by the processor in formulating vocal guidance instructions for transmission over the loudspeaker.

Guidance instructions to be transmitted to the driver via the display and/or loudspeaker are coordinated with the progress (that is the position) of the vehicle along the selected route, by means of output signals

MIT 03574

4 GB 2 079 453 A 4

provided by one or more position feed-back devices 40. Such devices may comprise on the one hand a relatively simple "elapsed-time" indicator 40 A, or a "distance-travelled" indicator 40 B driven from a transmission system (e.g. a propeller shaft) of the vehicle. Alternatively the position feed-back device may comprise a more sophisticated device such as for example an integration system 40 C incorporating means for integrating changes in vehicle compass heading and speed and providing in response thereto vehicle position map coordinates; or an inertial navigating system 40 D likewise arranged to provide vehicle position map coordinates; or an earth satellite navigation system 40 E arranged to provide an output derived from bearing observations of earth satellites; or a radio navigation system 40 F for providing output signals based on the observation of bearings of specific radio beacons.

10 The system 12 is connected for power supply through an ON/OFF switch (not shown) to the electrical system of the vehicle. 10

The "function control" buttons 22 (referred to hereafter as "function buttons") include the following, for effecting the following operations:-

- | | | | |
|----|--------------------------|---|----|
| 15 | (a) an "Advance" button | — proceed to next guidance instruction; | 15 |
| | (b) a "Step-back" button | — step back to the preceding road section (this allows the instructions for that road section to be reviewed); | 20 |
| 20 | (c) a "Confirm" button | — repeat current instruction; | |
| 25 | (d) a "Start" button | — give initial instruction for starting the journey; | 25 |
| | (e) a "New Data" button | — receive new starting and finishing position data about to be keyed in; | 30 |
| 30 | (f) a "CANCEL" button | — cancel the previously stored selected route and adopt the newly selected route; and | |
| 35 | (g) a "Calibrate" button | — adjust multiplier to recalibrate the distance output signals derived from the distance feed-back device 40 B. | 35 |

40 The data-entry keys 24 include keys for enabling the driving to feed-in:- 40

- (a) the names of the starting and finishing positions of the desired journey (or alternatively codes representing or designating those names, for example the map coordinates of those respective positions);
- 45 (b) which of the various available optimizing criteria is/are to be used in assessing and selecting the optimum route from the various possible routes; 45
- (c) other data such as latest running cost per mile based on car and engine size, and the latest fuel prices.
- The map data storage element 28 incorporates for every road section in a particular map section data comprising:-

- | | | |
|----|---|----|
| 50 | (1) the map coordinates of the ends of the road section; | 50 |
| | (2) the length of that section; | |
| | (3) the road name (if any); | |
| | (4) the road number (if any); | |
| | (5) the section travelling times using the respective criteria; | |
| 55 | (6) the costs of travelling along the section for each of the travelling times referred to at (5) above; and 55 | |
| | (7) the direction of the section. | |

In use, after first energizing the system 12, the driver wishing to travel between starting and finishing points A and B on the same map section selects the map storage element 28 appropriate to that section and inserts it into the map data input module 26. Thereafter, he activates that module to cause the map data to be read from that storage element via the processor into the data storage unit 32, where it is stored for use later.

60 Then using appropriate data entry keys 24 the driver keys-in the identities of the starting and finishing places A and B, and also the criterion/criteria that he wishes the system to use in determining the selection of his route, for example that he wishes to travel from A to B in the shortest running time (rather than for example along the shortest distance).

65 Now, having been given the starting and finishing positions, the processor 18 proceeding under the 65

MIT 03575

5

GB 2 079 453 A

5

control of the ROM 30 and using the data defining, describing and qualifying the various road sections as stored in the data storage unit 32, assembles in turn various possible routes between the starting and finishing positions, and then using the selected optimization criterion/criteria (stored in the ROM) compares one route with another to find that route which provides the optimized selected condition/conditions.

5 The identities of the road sections constituting this optimized route are then stored in the data storage unit 32 for subsequent use in guiding the driver section by section along that route.

On depression of the "start" button, the first and second road sections of the stored route are extracted from the data storage unit 32 together with their relevant particulars, and a first guidance instruction identifying the road, and its direction, to be taken in order to leave A is formulated and announced to the driver. Thereupon the journey may be commenced.

10 A second guidance instruction, to instruct the driver what action is required at the junction of the first and second road sections, is also formulated and stored, until replaced later, in the data storage unit 32.

Alongside the second instruction are assembled (a) the distance to be travelled by the vehicle before the second instruction is to be announced to the driver, and preferably also (b) the distance at which this second instruction is to be acted upon by the driver. The said distances may also be accompanied, if required, by the map coordinates of the respective positions at which said second instruction is to be announced and acted upon.

20 These distances and/or corresponding map coordinates are compared continuously in the processor 18 with the respective distances and/or map coordinates that are being supplied continuously by the corresponding vehicle position feed-back devices 40, and respective "annunciation" and "change road section" control signals are emitted by the processor when the corresponding feed-back distances and/or map coordinates equate with the respective stored distances and/or map coordinates.

The first control signal ("announce guidance instruction") operates to cause the said second guidance instruction to be announced to the driver, so that he may shortly act upon it, whilst the second of the control signals ("change road section") is used to automatically cancel the second instruction, preferably only if the system detects or has been advised by the driver that the instruction has been correctly acted upon, or if the system has no indication that the instruction has been carried out or properly carried out, to advise the driver of the need for (and also the nature of) appropriate corrective action.

30 Instead of providing for the automatic cancellation of the second guidance instruction, by causing the processor to access the vehicle's movement at and about the position for taking action, and comparing it with the guidance instruction, such cancellation may be made dependent instead upon action (for example depressing the "advance" button) by the driver to indicate that he has acted upon that guidance instruction and is now ready to receive at an appropriate instance the next (third) guidance instruction.

35 The third guidance instruction is produced by the processor 18 after first requesting and receiving into its own internal memory from the data storage unit 32 the identity and relevant particulars of the third road section, that third instruction then being deduced and formulated by the processor from a comparison of the data concerning the junctions of the second and third road sections with each other. This third instruction includes the said distances (and where desired, the corresponding map positions) to the respective positions for announcing, and, where appropriate, for acting upon this third guidance instruction.

40 The third guidance instruction is announced to the driver automatically when the processor detects coincidence of the distance travelled along the second road section by, or of the position on that road section of, the vehicle, with the annunciation distance or position identified within the third guidance instruction.

Further successive guidance instructions are produced in turn by the processor each time an indication (automatic or driver-originated) is received by the processor that the last instruction has been correctly acted upon, and the identity and relevant particulars of the next road section ahead have been subsequently received by the processor from the data storage unit 32.

Each successive guidance instruction is announced to the driver automatically when the processor detects coincidence of the distance travelled along a current road section by, or of the position on that road section of, the vehicle, with the annunciation distance or position identified with that guidance instruction.

50 Typical instructions and their associated distance data for travelling from the town of Guildford to the town Dorking are shown in the following Table.

MIT 03576

6

GB 2 079 453 A

6

TABLE
Route - Guildford to Dorking

Inst'n No.	Section Distance (Miles)		Total Distance (Miles)
(1)	0.0	Leave Guildford Follow signs for Merrow	0.0
(2)	0.3	Bear Right Follow signs for Merrow	0.3
(3)	1.2	At Merrow Straight on	1.5
(4)	1.0	Turn Right Follow signs for Dorking, Reigate, Newlands Corner	2.5
(5)	1.2	At Newlands Corner Straight on Follow signs for Dorking, Reigate, Shere	3.7
(6)	2.1	At Shere Bear Left Follow signs for Dorking, Reigate, Abinger Hammer	5.8
(7)	3.2	At Abinger Hammer Bear Left Follow signs for Dorking, Reigate, Westcott	9.0
(8)	2.6	At Westcott Straight on Follow signs for Dorking, Reigate, Redhill	11.6
(9)	2.4	At Dorking	14.0

MIT 03577

7

GR 2 079 453 A

7

In the event that the driver finds that road, weather, or other conditions are undesirably impeding his progress along the route, it is possible for him to request the processor, whilst continuing to store the presently selected route, to work out a new route between his present vehicle position and his destination B, either via some driver-selected intermediate position which lies off the present selected route, or avoiding the road sections ahead on which travelling difficulties are known (for example, from a broadcast traffic news bulletin) to exist. The newly selected route can be adopted by depressing the "Cancel" button.

In the event that a projected journey extends from one map section to another, a driver must seek a route on the first map section to some driver-selected, convenient, intermediate position on or near the boundary of that map section, and after completing that part of his journey on the processor-selected route, enter the map data appertaining to the second map section (after first inserting the appropriate map storage element 28), and then enter that intermediate position as his starting position for the second part of his journey, as well as his final destination. Thereby he will be guided along an optimized route between the intermediate position and the final destination.

Alternatively, the apparatus may be modified to include a larger data storage unit 32 capable of holding the data of two map sections, and then to receive successive map data entries from the two map sections as stored on two different map data storage elements 28. In that way, the processor is enabled to analyse and select an optimum route between starting and finishing points which are disposed on adjacent map sections respectively.

The guidance instructions may be announced to the driver either vocally via the loudspeaker or earphone 36, or visually via the visual display unit 34, or they may be announced simultaneously using both visual and vocal enunciating means. The visual display unit 34 may be arranged to display an instruction only once and for a limited period of time, or repeatedly at intervals during the period of its currency.

Furthermore, the processor may be arranged to maintain the visual display unit energized to display the next guidance instruction from the time of its formulation by the processor until the time of its subsequent cancellation by the automatic or driver-produced "action-acted-upon" signal.

Alternatively, the processor may be arranged to energize the visual display unit only temporarily on formulation of the next guidance instruction, and to subsequently re-energize it at the said detected time for announcing that instruction.

Where an instruction is not displayed continuously, as mentioned above, from the time of its formulation to the time of its cancellation, the driver has the option at all times to look ahead by depressing the "confirm" function button, whereby to cause the current (that is the next to be acted upon) instruction to be announced temporarily by either or both of the vocal and visual means (or in the case of the visual means, even through to the time of acting on that instruction).

The processor may, if desired, be connected with the control system for operating the vehicle's direction indicators, and be arranged to automatically energize at the appropriate moment the appropriate direction indicators in accordance with the current guidance instruction.

It will be appreciated from the foregoing that with the system specifically described above:-

(a) the driver has available to him in his vehicle, in the form of the map storage elements 28, a complete road system of the relevant area, which system can be searched for any journey between any two points in that road system, according to one or more optimization criteria, and that the searching can be carried out very quickly and at any time before or during a journey to meet changed or changing conditions, as forecast or actually met on the roads;

(b) the driver is relieved of the need to keep track of his position on the map and moreover to memorize successive instructions; and

(c) the selection of the optimum route is carried out methodically, reliably, and exhaustively, and is based on information recorded in map storage elements that are capable of being updated from time to time as the need arises.

The data storage unit 32 may be of any suitable kind, including those of the sequential access variety, for example a bubble memory.

The map data may be recorded on any convenient form of data storage element 28, for example on discs or tapes. Tapes offer the advantage that they could be inserted in and read by tape decks that are increasingly being installed in vehicles for the purpose of playing music and speech.

Alternatively, the map data storage element may take the form of a "library module" chip storage device, similar to those now being used in small pocket calculators.

Whilst the map data storage elements 28 have been disclosed above as covering various contiguous, and possibly overlapping, sections of a road system, it should be appreciated that such sections of a road system may each cover a fairly large area of the country, or alternatively a much smaller area. The former may be used to enable route selection and guidance over long distances, whilst the latter would be suitable for enabling route selection and guidance over relatively short distances, for example for navigating a route through a town or urban area. Hence, a complete library of map data storage elements would comprise a series of the former elements, covering the whole of the country or an area in question (e.g. the United Kingdom), and a series of the latter elements covering the respective large towns and urban areas. In fact, using the latest techniques for storing large volumes of data in a compact storage medium, it is feasible to have the data for the whole of a country such as the United Kingdom recorded on a single, compact memory element which is permanently connected into the processor. To supplement that storage unit, map data for

MIT 03578

8 GB 2 079 453 A

8

specific towns could be supplied on individual storage elements 28 for insertion into the map data entry module 26.

The processor may also be arranged to display on the visual display unit the increasing total mileage of a distance covered on a journey so far, together if desired with the increasing distance covered since the last guidance instruction was cancelled, (or if desired the decreasing distance to be travelled before the next point of which the current guidance instruction is to be acted upon).

Since the distance-travelled measuring means 40 B driven from the car's transmission system is dependent for its accuracy on the state of the car's tyres and their inflation pressures, it may be necessary from time to time to adjust the calibration of that distance travelled measuring means. This is performed by appropriate manipulation of the "calibrate" function button 22 to adjust a multiplying constant for said distance travelled measuring means. Such re-calibration would normally be made en route after a known distance has been travelled.

The data processor may also be arranged to compute indications of average running speeds, from the indications of the distance-travelled measuring means 40 B and elapsed-time measuring means 40 A, for the total journey so far, and/or for the part of the current road section so far covered. Such average speeds would be displayed on the visual display unit, and could be vocally announced at the time of giving each guidance instruction to the driver.

Whilst the simple elapsed-time or distance measuring feedback devices (40 A or 40 B) may suffice for providing adequate feed-back data, the provision in addition of one of the more complex position feedback devices 40 C to 40 F (for example the inertial guidance system 40 D) has the advantage of providing a back-up for the simple feed-back device, and, moreover, that a compass heading is also provided as an additional checking means.

Though the system described above provides for both vocal and visual announcement of guidance instructions, in a simpler version of the system it is preferred to provide vocal announcements in preference to visual announcements.

Whereas the use of the system has been described in relation to the driver keying-in his information concerning the starting and finishing positions, the optimization criteria to be used, and etc., the driver may alternatively, and preferably, input his information vocally by means of the microphone 29. For this purpose, the processor is programmed to compare the driver's spoken instructions, using a specific and limited vocabulary of phrases, words and syllables, as stored in the vocabulary unit 38, with the contents of that unit, and to use those decoded vocal instructions in place of the alternative keyed-in information that the driver might otherwise have used.

The vocal mode of communication between the driver and the processor is preferred since it involves less distraction of the driver's attention from his prime task of driving the vehicle. To produce the vocal guidance instructions for the driver, the processor 18 is caused to select and string together sounds taken from, or synthesized in accordance with, those stored in the vocabulary unit 38, the instructions for the formulation of those vocal instructions being produced by the processor.

In a system using the elapsed-time measuring device 40 A, it is necessary to provide adjustment means (like those mentioned above in respect of the distance-travelled measuring device 40 B) for adjusting the calibration of the device 40 A from time to time, to match the calibration to the known or expected average speed of the car.

Whereas in the above-described system, guidance instructions have been derived from a pre-planned route that has been compiled on demand by the data processor, in a simpler system the data processor is replaced by a storage means housing a plurality of sets of pre-planned routes, each comprising a sequence of route-storage instructions, and an associated selection means operable by the driver for selecting which of the several routes he wishes to follow. That simpler system operates in a manner generally similar to that described above to announce and cancel each successive guidance instruction of the selected route at appropriate times in dependence upon the progress of the car.

60 CLAIMS

1. In or for a vehicle (as hereinbefore defined), a route guidance apparatus comprising:-

(a) *instruction producing means* for producing in sequence from a pre-planned route individual route-stage instructions each defining an action to be taken by a driver of a vehicle at the end of an associated route-stage, each such instruction including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him;

(b) *feedback signal producing means* for producing feed back signals representative of the progress of the vehicle along the route-stage, each such feedback signal being representative directly or indirectly of the position of the vehicle on said route-stage;

(c) *instruction announcing means* for announcing to the driver, on its being activated, a said instruction represented by output signals of the instruction producing means;

(d) *signal comparison means* for comparing during each said route-stage said reference and feedback signals and for activating said instruction announcing means when said reference and feedback signals correspond, thereby to announce to the driver the instruction associated with the said reference signal, and

MIT 03579

(e) activating means for activating said instruction producing means thereby to cause it to produce the next route-stage instruction in the sequence in place of a current one.

2. Apparatus according to Claim 1, wherein said activating means is driver-operable.

3. Apparatus according to Claim 1, wherein each route-stage instruction produced by said instruction producing means also includes an additional reference signal which represents the intended vehicle position at the end of the associated route-stage, at which position the driver should act on that instruction; and including comparison means for comparing during each route-stage said feedback and additional reference signals and for stimulating said activating means when said feedback and additional reference signals correspond, thereby to cause said instruction producing means to produce the next route-stage instruction in the sequence in place of the current one.

4. Apparatus according to any preceding claim, wherein said instruction producing means is arranged to store a plurality of sets of route-stage instructions for enabling a driver to be guided along various routes respectively; and

wherein said instruction producing means includes driver-operable route selection means for enabling a driver to select from said various routes a specific one along which he wishes to be guided, said instruction producing means being operative on selection of a route to produce in sequence and as required by said activating means the successive route-stage instructions appertaining to the selected route.

5. Apparatus according to Claim 4, wherein said route selection means includes driver-operable selection means for identifying the starting and finishing positions of a journey for which guidance is required, and means for automatically selecting from said plurality of sets of route-stage instructions the set having the driver-identified starting and finishing positions, thereby to cause the desired set of route-stage instructions to be produced in sequence and as required by said activating means.

6. Apparatus according to any one of the Claims 1 to 3, wherein said instruction producing means includes

a route compiling means for compiling each said pre-planned route on being required by a driver, and a driver-operable journey selection means for identifying the starting and finishing positions of a journey for which guidance is required,

said route compiling means including -

(a) a data processing means,

(b) a map data storage means for storing map data defining and describing the respective road sections of a road system on a predetermined map section, each such road section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him,

(c) a program storage means for storing programs for controlling the operation of the data processing means, and for causing it to carry out, on request and according to a predetermined optimization criterion, a route evaluation and selection process to determine an optimum route between the driver-identified journey starting and finishing positions on the said map section, and means for storing that optimum route and announcing route-stage instructions appertaining to it in sequence as required by said activating means.

7. Apparatus according to Claim 6, wherein said program storage means has stored within it alternative programs, or program modifiers, for enabling the data processing means to carry out on request route evaluation and selection processes according to any one of a plurality of different optimization criteria, and wherein there is provided driver-operable optimization criterion selection means for selecting for a particular journey to be undertaken the particular optimization criterion or criteria to be used.

8. Apparatus according to Claim 6 or Claim 7, wherein said data processing means is also arranged to carry out the functions of the respective comparison means for comparing on the one hand said feedback and reference signals, and on the other hand said feedback and additional reference signals.

9. Apparatus according to any one of the Claims 6 to 8, wherein said map data storage means has associated therewith map data entry means for receiving removable map data storage elements, whereby data appertaining to any desired area of a map may be entered into said map data storage means for use temporarily by said data processing means.

10. Apparatus according to any one of the claims 6 to 9, including a vocal input means for receiving a driver's spoken input information identifying a journey to be undertaken, and wherein said data processing means is arranged to decode that vocal input information and to act upon it in selecting a route for a journey to be undertaken by the driver.

11. Apparatus according to any one of the Claims 6 to 10, wherein said instruction announcing means is arranged to announce each said route-stage instruction in vocal form, and wherein said data processing means is arranged to produce and/or control signals for vocalizing said instructions.

12. Apparatus according to any one of the Claims 1 to 5, wherein said instruction announcing means is arranged to announce each said route-stage instruction in vocal form.

13. Apparatus according to any one of the claims 10 to 12, wherein said instruction announcing means is also arranged to announce each route-stage instruction in visual form.

14. Apparatus according to any preceding claim, wherein said feedback signal producing means comprises an elapsed-time measuring means arranged to be carried by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependent on the time that has elapsed since last being activated.

15. Apparatus according to any one of the Claims 1 to 13, wherein said feedback signal producing means

10 GB 2 079 453 A

10

comprises a distance measuring means arranged to be driven by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependant on the distance travelled by the vehicle along the route-stage since last being activated.

16. Apparatus according to any one of the Claims 1 to 13, wherein said feedback signal producing means comprises an inertial-guidance position determining means arranged to be carried by said vehicle and to compute from vehicle motion the position of the vehicle, and to provide an output vehicle-position-indicating signal dependant on said position for comparison with position indicating signals constituted by said reference and/or said additional reference signals incorporated in said route-stage instructions.

17. Apparatus according to any one of the Claims 1 to 13, wherein said feedback signal producing means comprises a vehicle position determining means arranged to be carried by said vehicle and to compute, from bearing of objects disposed externally of the vehicle on or around the earth's surface, the position of the vehicle, and to provide an output vehicle-position-indicating signal for comparison with position-indicating signals constituted by said reference and/or said additional reference signals incorporated in said route-storage instructions.

18. Apparatus according to Claim 14, including driver-operable adjustment means for adjusting the calibration of said elapsed-time measuring means in dependence upon and to compensate for variations in average speed of the vehicle's travel.

19. Apparatus according to Claim 15, including driver-operable adjustment means for adjusting the calibration of said distance measuring means in dependence upon and to compensate for variations in the effective road wheel diameter of a road vehicle in or for which said guidance apparatus is intended to be used.

20. Apparatus according to any one of the Claims 14 to 19 when appended to Claim 6 (as dependent itself on Claim 3), or to any other claims that is dependent directly or indirectly on Claim 6 (as dependent itself on Claim 3), wherein said data processing means is programmed to compare with each route-stage instruction the vehicle motion in the vicinity of the said point at which said instruction should be acted upon, and to advise the driver of any lack of correspondence between the said vehicle motion and the said associated instruction.

21. Apparatus according to any preceding claim, wherein each said route-stage instruction is represented in electrical signal form, and said reference, additional reference, and feedback signals comprise electrical signals.

22. A method of guiding a driver of a vehicle (as hereinbefore defined) along a multi-stage route between journey starting and finishing positions, comprising -

(a) generating and storing for said route a sequence of individual route-stage instructions each defining an action to be taken by the driver at the end of the associated route-stage, and each including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him;

(b) extracting a said instruction that is associated with a first route-stage and holding it ready for announcement to the driver;

(c) generating a feedback signal representative of the progress or position of the vehicle along the route-stage;

(d) comparing said reference and feedback signals,

(e) announcing the extracted instruction to the driver when said reference and feedback signals correspond;

(f) indicating when the vehicle has passed into the next route-stage; and

(g) repeating cyclically in turn the steps (b) to (f) above for the second and subsequent instructions in the sequence.

23. A method according to Claim 22, wherein each said route-stage instruction generated in said step (a) above also includes an additional reference signal representing the intended vehicle position at the end of the associated route-stage, at which position the driver should act upon that instruction; and wherein the step (f) above comprises comparing said feedback and additional reference signals and indicating when said feedback and additional reference signals correspond that the vehicle has passed into the next route-stage.

24. A method according to Claim 22 or Claim 23, including the preliminary step of - specifying the starting and finishing positions of a journey for which guidance is required, and the criterion or criteria to be used in selecting an optimum route between those positions, and wherein in the said step (a) said sequence of instructions is obtained by generating from stored map data defining and describing the respective road sections of a road system (each such section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him) the optimum route between the specified starting and finishing positions and based on the specified optimization criterion or criteria, and storing the route-stage instructions for the successive route-stages making up that optimum route.

MIT 03581

25. A route guidance apparatus substantially as hereinbefore described with reference to and illustrated in the accompanying drawings.

26. A route guidance method substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

Printed for Her Majesty's Stationary Office, by Croydon Printing Company Limited, Croydon, Surrey, 1982.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

MIT 03582

Exhibit

GG

MAR-17-2006 14:51

SAE

724 776 0002 P.02

SAE *The Engineering Society
For Advancing Mobility
Land Sea Air and Space®*

400 COMMONWEALTH DRIVE WARRENDALE, PA 15096

SAE Technical Paper Series

881177

An Expert System for In-Vehicle Route Guidance

Andrew Silverman

Navigation Technologies Corp.

**S. A. E.
LIBRARY**

8/23/88

**Future Transportation Technology
Conference and Exposition
San Francisco, California
August 8-11, 1988**

HAR 102367

MAR-17-2006 14:52

SAE

724 776 0002 P.03

The appearance of the code at the bottom of the first page of this paper indicates SAE's consent that copies of the paper may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per article copy fee through the Copyright Clearance Center, Inc., Operations Center, P.O. Box 785, Schenectady, N.Y. 12301, for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

Papers published prior to 1978 may also be copied at a per paper fee of \$2.50 under the above stated conditions.

SAE routinely stocks printed papers for a period of three years following date of publication. Direct your orders to SAE Order Department.

To obtain quantity reprint rates, permission to reprint a technical paper or permission to use copyrighted SAE publications in other works, contact the SAE Publications Division.



All SAE papers are abstracted and indexed in the SAE Global Mobility Database

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

ISSN 0148-7191

Copyright © 1988 Society of Automotive Engineers, Inc.

Positions and opinions advanced in this paper are those of the author(s) and not necessarily those of SAE. The author is solely responsible for the content of the paper. A process is available by which discussions will be printed with the paper if it is published in SAE Transactions. For permission to publish this paper in full or in part, contact the SAE Publications Division.

Persons wishing to submit papers to be considered for presentation or publication through SAE should send the manuscript or a 300 word abstract of a proposed manuscript to: Secretary, Engineering Activity Board, SAE.

Printed In U.S.A.

HAR 102368

MAR-17-2006 14:52

SAE

724 776 0002 P.04

881177

An Expert System for In-Vehicle Route Guidance

Andrew Silverman

Navigation Technologies Corp.

ABSTRACT - The Route Guidance Expert (ROGUE) is an interactive software system and associated database under development by Navigation Technologies which provides in-vehicle navigation assistance for day-to-day driving situations.

This paper describes the features, functions, and benefits of the ROGUE software and NavTech's comprehensive U.S. digital street map database.

Through the use of vehicle-mounted sensor hardware, the ROGUE software monitors progress during travel and is aware of vehicle location relative to the database and the route being driven. Using this information:

- guidance is presented at the specific time and location where turns or other such actions are needed, and
- driving errors are automatically detected and revised directions prepared.

DESIGN CONCEPTS

The primary purpose of any vehicle navigation system is to assist a driver in finding a particular destination. To date, vehicle navigation systems in the U.S. have addressed this need primarily by focusing on automated location devices, essentially electronic street maps which display a vehicle's location and the surrounding streets. While such systems have had limited acceptance in commercial markets, they have not proven attractive to the average consumer.

To provide a service which is attractive to the noncommercial driver, a system which can provide expertise beyond that of a map, electronic or otherwise, is required. Six

ROGUE (the Route Guidance Expert) is an interactive software system for autonomous in-vehicle navigation guidance which provides navigation assistance for day-to-day driving situations. ROGUE is currently under development by Navigation Technologies Corporation (NavTech) for incorporation into vehicle navigation systems on an OEM basis. The ROGUE software offers drivers:

- automated route generation to any location covered by its onboard database,
- navigation guidance during travel,
- step-by-step directions using synthesized speech, and
- step-by-step text and graphic displays of turns and intersections.

0148-7191/88/0711-1177\$02.50

Copyright 1988 Society of Automotive Engineers, Inc.

HAR 102369

MAR-17-2006 14:52

SAE

724 776 0002 P.05

881177

2

specific concepts which maximize both the utility of a vehicle navigation system to the average car driver and its current economic and technological effectiveness underlie the design of the ROGUE software.

1) PROVIDE ROUTE PLANNING EXPERTISE - Driving involves not only knowing where one is going, but more importantly how to get there.

Particularly when driving in one's local area, vehicle location and basic street information is often known to the driver. To be useful to drivers in their daily activities, a navigation system must also assist the driver in planning an effective route to his or her destination, a challenging task even in one's own city or town.

For example, a driver may know the generic type of destination he or she would like to travel to, but may not have a specific location in mind. Thus the system needs to be able to answer questions about businesses and their locations such as 'How do I get to the nearest florist?'. The ROGUE software and associated geographic database provide a sophisticated level of expertise in planning efficient routes, not only when in an area which is completely unknown, for instance during trips or sight-seeing, but also during normal day-to-day driving in nominally familiar areas.

2) PROVIDE EFFECTIVE AND EFFICIENT DIRECTIONS - In order to provide drivers efficient and effective directions, large amounts of information regarding the area being travelled are required.

Details of the street network such as stop light

locations, turn restrictions at intersections, and signs at freeway entrances and ramps are all significant issues in real-world driving situations.

In selecting routes, drivers consider factors beyond the basic street layout such as road and traffic conditions and these must also be known to the system.

The choice of a route may also be dependent on the driver's interest in minimizing time or distance or in taking a scenic route. In the later case, the system should also be able to note points of interest along the route.

The ROGUE software, utilizing NavTech's extensive navigation database, provides the varied sorts of information needed for effective vehicle navigation.

3) PROVIDE NAVIGATION GUIDANCE DURING TRAVEL - The most comfortable form of navigation guidance for most drivers is interacting with a passenger who is familiar with the route being driven. The system must address this primary desire of drivers in seeking directions: to get expert guidance while they are actually driving.

The ROGUE software provides to the driver an analog of a knowledgeable passenger giving driving directions both through the use of spoken instructions and in giving its guidance when and where driving actions are needed.

4) DETECT DRIVING ERRORS - Missed turns, wrong turns and other driving errors are common events in day-to-day driving. The system must detect, and provide guidance in correcting, driving errors.

The ROGUE software constantly monitors vehicle

HAR 102370

MAR-17-2006 14:53

SAE

724 776 0002 P.06

881177

3

location relative to the database and the route being travelled. Any deviations from a planned route are immediately detected by the system, the driver is notified of the error, and new directions are prepared for reaching the destination.

5) OPERATE WITHOUT EXTERNAL EQUIPMENT - Although many proposed route guidance systems have included the use of external sources of information such as satellite networks or terrestrial guideposts for tracking the location of the vehicle during travel, these approaches present both technical and economic difficulties. The limitations on coverage and reception for broadcast information and the high cost currently associated with both the transmitters and car-mounted receivers of this information rule out their use in a commercial system at this time.

While the ROGUE software could be utilized with external data sources in the future, the software is optimized for self contained systems and requires no information from, or interaction with, anything other than the car and driver.

6) MAXIMIZE DRIVER COMFORT AND SAFETY - A driver is faced with many decisions while operating a vehicle. A route guidance system must not only assist the driver in reaching his or her destination but must do so without distracting the driver or otherwise reducing driving safety.

The ROGUE software is designed with a strong attention to the comfort and safety of the vehicle operator. Through the presentation of directions in simple spoken and graphic form

and automated detection of driving errors, ROGUE minimizes the impact of navigation guidance on the driver's concentration while alleviating the distraction of worrying about becoming lost during travel.

ARCHITECTURE

ROGUE is comprised of computer software and a database of detailed information on the area being travelled. When operational in a vehicle environment, unique hardware is used for interacting with the driver and for sensing changes in the position of the vehicle. A basic block diagram of a navigation system using ROGUE is given in figure 1.

HARDWARE - The hardware required by the ROGUE software consists of four primary components:

- A microcomputer system which executes the ROGUE software,
- A video display, speech synthesizer, and keyboard for interacting with the driver,
- Sensors providing information on vehicle location, and
- Database storage.

A schematic diagram of the basic hardware required in a ROGUE-based system is shown in figure 2.

Computer System - The ROGUE software is intended to execute on a microcomputer system powered from a vehicle's 12V battery, consisting of the following elements:

- 32-bit Central Processing Unit
- Real Time Clock
- Random Access Memory
- Interface to database storage
- Interface to driver interface hardware
- Interface to sensor hardware

HAR 102371

Exhibit

GG

Part 2

MAR-17-2006 14:53

SAE

724 776 0002 P.07

881177

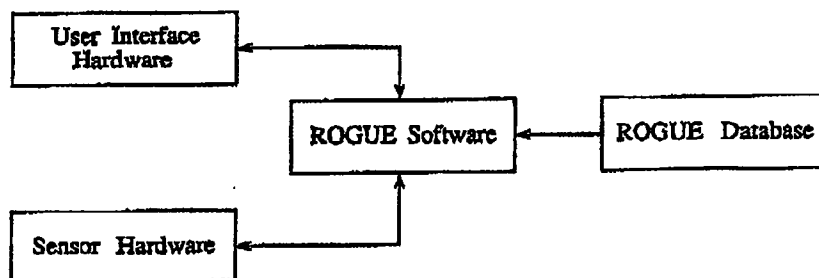


FIGURE 1 - ROGUE-based System Block Diagram

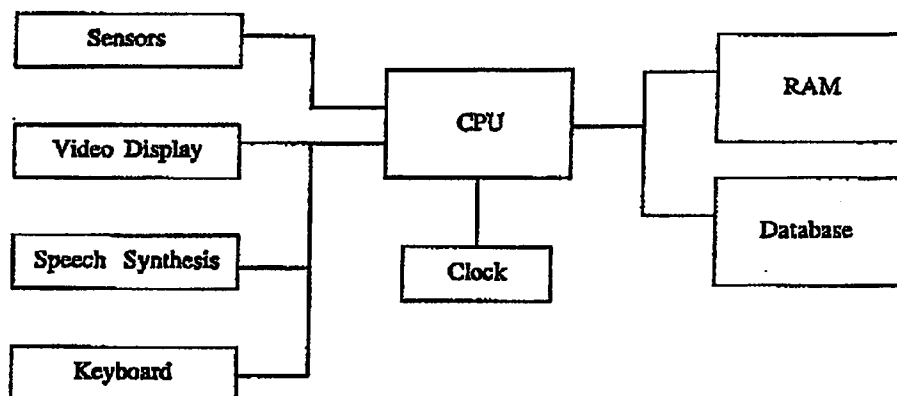


FIGURE 2 - Hardware Required by ROGUE

Driver Interface -
 Navigation guidance and other requested information is presented to the driver by the ROGUE software using a video display mounted in the vehicle's instrument cluster. The display may be color or monochrome unit which which can display textual and line graphic information. In addition to the video display, a speech synthesis unit is employed for providing directions.

At the driver's request, the speech synthesizer can produce either spoken directions or an audio chime which alerts the driver to an impending need to view directions displayed on the video screen.

Driver input to the ROGUE software is via an alphanumeric keyboard which allows the driver or a passenger to inform the system of desired destinations and other commands and wishes.

HAR 102372

MAR-17-2006 14:53

SAE

724 776 0002 P.08

881177

5

Sensors - The ROGUE software obtains information on the direction and distance traveled during driving from sensors mounted on the vehicle. This information is constantly monitored by the software to track the vehicle's location and its progress along a route. This allows the software to inform the driver of upcoming turns, detect deviations from planned routes, and predict expected arrival time.

The type of sensors used by the ROGUE software is dependent on the make and model of vehicle in which it is installed. Sensor alternatives include:

Distance
Odometer
Wheel sensors
Accelerometer

Direction
Differential Odometer
Steering sensors
Electronic compass

Although the ROGUE software is compatible with external sources of position information such as satellite broadcasts, their use is not currently envisioned due to economic considerations.

Database Storage - The ROGUE database map be stored in semiconductor memory (EPROM or PROM) or on rotating storage media such as Compact Disk (CD). When used with a CD for database storage, the design of the ROGUE software is such that a single CD drive may be used for navigation and audio. A ROGUE database disk need only be present in the CD drive during route definition and planning and may be removed during travel when audio use of the CD is desired.

SOFTWARE - The ROGUE software performs all the functions essential to providing

an effective navigation system for consumer use:

- Controlling the driver interface hardware
- Interacting with the driver to define destinations
- Accessing the database for navigation information
- Planning efficient routes
- Monitoring vehicle sensors
- Tracking vehicle position relative to the database
- Giving directions while driving
- Detecting deviations from planned routes
- Planning routes to correct deviations

The ROGUE software is a dedicated application package which presents a simple, easy to use interface to the driver for route planning and guidance and performs its other functions without driver intervention or knowledge. The software is initialized and presents an initial list of navigation options to the driver automatically when the vehicle is started.

DATABASE - NavTech's navigable database is the heart of ROGUE's navigation guidance capabilities. The database contains information on all major US metropolitan areas including not only street mapping but also information on businesses, points of interest and traffic patterns. A ROGUE-based navigation system contains a database for at least one metropolitan area in which the vehicle is commonly used along with the US interstate road network. Databases are easily interchanged should a driver travel to another metropolitan area.

The information available in the NavTech database includes:

- Street names
- Precise distances
- Speed limits
- Freeway exits, entrances,

HAR 102373

MAR-17-2006 14:54

SAE

724 776 0002 P.09

6

881177

- including correct road sign text
- Intersection turn restrictions
 - One-way streets and divided roads
 - Traffic signals and stop lights
 - Expected traffic patterns
 - Known/planned construction
 - Business locations
 - Tourist attraction locations
 - Public transit and walking routes
 - Truck restrictions
 - Time of day restrictions

FUNCTIONS

Providing navigation assistance to consumers involves three basic activities:

- 1) **PLANNING** - Interacting with the driver to select a destination and defining an efficient route to that destination.
- 2) **GUIDANCE** - Providing directions to the driver and informing him of any driving errors.
- 3) **POSITIONING** - Tracking

vehicle progress while travelling and detecting driving errors.

ROUTE PLANNING - The route planning function involves specification of a destination by the driver or passenger and the definition of a route from the vehicle's current location to that destination by the ROGUE software.

Selecting a Destination - A destination may be specified to the ROGUE software in a variety of ways:

- 1) A Street Address
- 2) An Intersection
- 3) A Business or other Point of Interest
- 4) The Nearest Instance of a Type of Point of Interest
- 5) A commonly used destination saved for the driver by the software.

A sample initial display presented by the software presents these choices, as shown in figure 3.

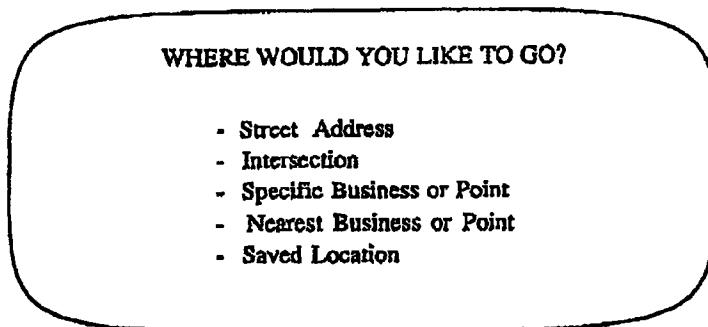


FIGURE 3 - Sample Destination Selection Display

Destinations are specified using the keyboard and video display. Destinations may be entered from the keyboard or by selecting a location from lists of choices presented by the

software.

Selecting a destination from lists - The use of lists of information for specifying a destination to the software is a simple process which requires

HAR 102374

MAR-17-2006 14:54

SAE

724 776 0002 P.10

881177

7

minimal time and effort. Further, lists can be scanned for possible destinations without having to know the exact name or spelling of specific streets or businesses. For lists longer than one screen of information, the driver or passenger can browse through the full list using the keyboard.

Based on the selection from the initial destination selection display, further screens are

presented. For example, if a street address is selected as the destination, alphabetized lists showing the cities and towns in the metropolitan area and the streets in the city or town the driver chooses are then used to specify the street for the destination, as shown in figures 4 and 5. Once the street and town has been specified, the street address desired is entered using the keyboard.

YOUR DESTINATION IS A STREET ADDRESS

PLEASE CHOOSE A CITY OR TOWN

- San Francisco
- San Jose
- Los Gatos
- Santa Clara

FIGURE 4 - Sample City Selection Display

YOUR DESTINATION IS A STREET ADDRESS

PLEASE CHOOSE A STREET IN SAN JOSE

- Brown Avenue
- E. Main Street
- W. Main Street
- Morrell Drive

FIGURE 5 - Sample Street Selection Display

Selecting a destination with the keyboard - For situations where the browsing options offered with lists are not needed, the driver may specify a destination by entering it directly with the keyboard. ROGUE automatically corrects misspellings, mismatched cities

and streets and other potential problems when destinations are specified from the keyboard.

ROUTE GENERATION - Once the driver has specified a destination, ROGUE automatically calculates a route to that destination.

HAR 102375

MAR-17-2006 14:54

SAE

724 776 0002 P.11

8

881177

Although many accurate computer algorithms for connecting two points have been developed, these algorithms are not wholly appropriate for vehicle navigation as they often produce routes that are more comfortable for computers than for drivers. The route generation software of the ROGUE software incorporates a sophisticated strategy, combining computational techniques with human intuitions about vehicle routing, designed to produce routes that will be not only accurate but also efficient and reasonable in the judgement of the driver.

The typical strategy employed by drivers when planning a route is to first look for important roads, such as freeways, going in the direction from their location to their destination and to then define routes from where they are to these roads and from them to the destination. Although in some cases the resulting routes may not be the most efficient, choosing to take a route using a freeway versus a slightly shorter route over surface streets for example, they are the most comfortable routes for drivers.

To achieve a corresponding level of driver comfort, ROGUE's routes are planned using a similar divide and conquer strategy which divides streets into several classes: major arteries, minor arteries, and surface streets.

At the beginning of its route planning process, ROGUE locates major arteries that efficiently traverse the distance between the current location and the destination. ROGUE then determines routes to get to and from these major arteries, using minor arteries where possible and surface streets where necessary.

Arteries and streets are selected to minimize the combination of time and distance required for the trip under current traffic conditions and employing a reasonably small number of turns.

ROGUE's routing software also employs a set of rules about navigation that mirror human judgements. For example,

- 1) Left turns are penalized versus right turns as they are both difficult and dangerous.
- 2) Small amounts of time and distance may be sacrificed to avoid making excessive numbers of turns.

Although ROGUE's routing software is based on human navigation strategies, it takes advantage of ROGUE's substantial computing power and the knowledge embedded in the NavTech database to produce routes that are both more efficient and accurate than can be generated by drivers using these same techniques.

- 1) ROGUE is aware of one-way streets, divided roads, U-turn restrictions, etc. and will not employ illegal or impossible actions.
- 2) Human drivers generally will stop their route planning once they find the first route to a destination, though better routes may be available. In picking major and minor arteries and surface streets, ROGUE searches its database extensively to select the most efficient route possible.
- 3) ROGUE's database contains information on traffic patterns and, based on the day and time maintained by its real clock, ROGUE will pick a route that is efficient for the day and time of travel.
- 4) ROGUE is aware of speed

HAR 102376

MAR-17-2006 14:55

SAE

724 776 0002 P.12

881177

9

limits, street lights, stop signs and other traffic flow information and considers these factors in determining the time required to traverse each artery or street.

ROUTE GUIDANCE - ROGUE offers four types of guidance to assist the driver in following a route:

- spoken guidance during travel,
- textual and graphic guidance during travel,
- a display of the time and distance in remaining in the trip during travel, and
- maps which may be displayed while the vehicle is stationary.

Textual directions - ROGUE's text directions focus on turns and are designed to mimic a good navigator sitting next to the driver.

To minimize the amount of time the driver has to divert his attention from the road to read

the text, only as much detail as is required is provided. For simple turns the distances between turns, the street to turn onto and the direction of turn is given. Entries and exits from limited access roads and tricky intersections are clarified with more detailed information such as street sign text.

Textual directions are in the form of simple English sentences each of which describes a driving action to be taken. A sample set of textual directions for a trip to a grocery store is shown in figure 6.

Graphic displays - ROGUE's graphic displays illustrate the layout of turns and intersections. These graphics show a simplified view of the streets surrounding a turn and the driving action required.

A sample graphic display is shown in figure 7.

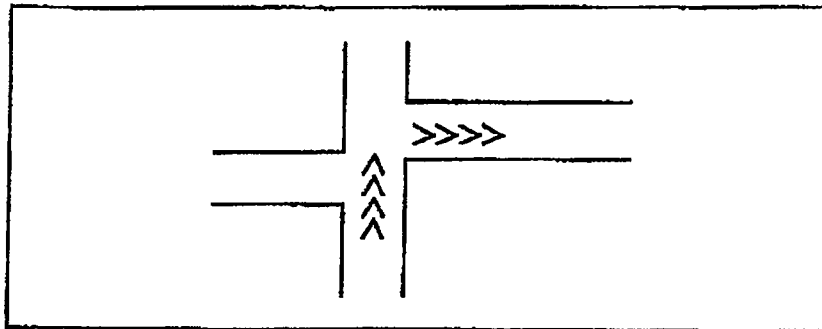


FIGURE 7 - Sample Graphic Display

DEPART Current Location to MORRELL DRIVE. Turn RIGHT on MORRELL DRIVE.

Drive 1.2 Miles on MORRELL to SUMMIT AVENUE. Take SUMMIT EAST EXIT and merge onto SUMMIT.

Drive .3 Miles on SUMMIT to E. MAIN STREET. Turn Right on E. MAIN.

Drive 100 YARDS on E. Main to JOE'S Market at 300 E. Main.

FIGURE 6 - Sample Directions

HAR 102377

MAR-17-2006 14:55

SAE

724 776 0002 P.13

10

881177

Guidance during travel - As discussed above, the ROGUE software uses its vehicle sensors to track the progress of the vehicle along a route. This information allows the presentation of navigation guidance to follow the progress of travel.

Both textual and graphic directions are displayed by ROGUE during travel. At the option of the driver, ROGUE can also provide its textual directions verbally.

During travel, graphic and text directions are displayed one instruction at a time on the display screen. As each step in the route is completed, the next instruction is automatically shown on the screen. Instructions are sufficiently small that the full scope of imminent events (i.e. several quick turns in series) can always be shown on the display screen. As the driver is traversing a route, the display screen shows all the information needed for the next step of the journey.

During travel, ROGUE decrements displayed distance information in the current instruction as that distance is traversed. For example, an instruction to drive 1.2 miles and turn would be updated to 1.1 miles after the first tenth mile is driven and reach 0.0 miles as the turn is reached. Once the turn is executed, ROGUE displays the next instruction.

If spoken directions are requested by the driver, the textual portion of the screen directions is spoken by the ROGUE speech synthesis hardware. As the distance displayed for an instruction approaches 0.0 miles and ROGUE detects that the vehicle is approaching a turn, the direction for the turn is spoken to the driver. If spoken

directions are not requested, an audio chime sounds at this point to alert the driver to review the instruction currently displayed and make the indicated turn.

In addition to displaying the distance to the next turn, ROGUE also displays distance and time remaining in the trip and shows the current location of the vehicle. A sample screen display during travel is shown in Figure 8.

Map displays - Where maps can helpfully supplement its directions, ROGUE also generates simple map displays. These are generally an overview of the route and details of small complex areas. These maps are useful for getting oriented at the start of a trip, at tricky intersections and exits during travel, and for finding parking lot entrances at the destination.

As spatial tasks such as map-reading are difficult and distracting even in the absence of competing tasks such as driving and thus unsafe while operating a vehicle, ROGUE's map displays are accessible only when the vehicle is stationary. The driver is expected to view the overview map and any detail maps for the area around the current location before setting off on the route and to view any detail maps for the destination either before departure or on arrival. Map displays are requested by the driver through the keyboard.

Recovery from driving errors - Although drivers tend to assume they won't make mistakes while driving, they often do. Accidentally passing a street where a turn is required, taking a wrong direction of turn, or turning on a wrong street are common events in day-to-day driving. The ROGUE software handles these occurrences by providing an alert through the

HAR 102378

MAR-17-2006 14:55

SAE

724 776 0002 P.14

881177

11

speech synthesis unit and directions to return to correct path when the driver deviates from a planned route. As ROGUE is always aware of

the vehicle's current location through its road sensors, detection of a driving error is immediate and directions are instantly recalculated.

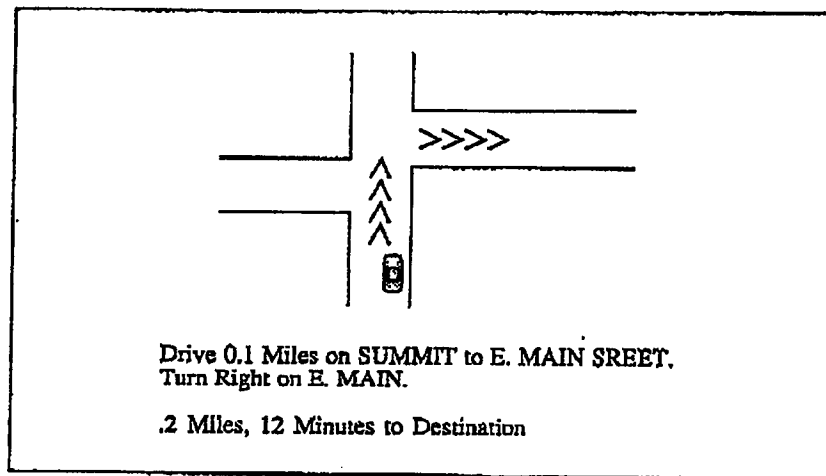


FIGURE 8 - Sample Display During Travel

POSITIONING

The technology used in the ROGUE software to track vehicle location is dead reckoning with map matching. Dead reckoning involves the use of sensor data to determine the direction and distance travelled from a known location. ROGUE's sensor hardware is monitored constantly by ROGUE's computer software.

As ROGUE is monitoring sensor data and updating the vehicle's position from this information, it is constantly comparing this calculated position to the street network stored in its database. By comparing vehicle change of direction with the street network, ROGUE can determine what streets and intersections are being traversed during travel and refine its view of the vehicle's

location accordingly. If, for instance, ROGUE detects through its direction sensors that the vehicle has just made a turn but its position sensors indicates the vehicle is in the middle of a block, ROGUE will locate in its database the street where the turn was made and update the vehicle's position to reflect that location. In this way, map matching allows total accuracy of positioning relative to the street network at all times and allows precise coordination of ROGUE's directions to the driver with the need to perform driving actions.

ROGUE's map matching procedures are also key to its abilities to detect and correct driving errors. As ROGUE is always aware of the precise position of the vehicle relative to the street network, an incorrect or missed turn is

MAR-17-2006 14:56

SAE

724 776 0002 P.15

12

881177

instantly recognized and can be corrected without serious loss of time by the driver.

DATABASE FEATURES

The NavTech database contains all the information necessary to plan and navigate routes through all US metropolitan areas.

STREET NETWORK - The NavTech database contains full longitude/latitude coordinates for all arteries, streets, on-ramps and off ramps. These coordinates also include altitude so that elevated roads and ramps and overlapping versus intersecting streets are known. The database encodes streets as series of segments which are straight portions of roadway. As streets are frequently not straight for their full length, segmenting roads allows the ROGUE software to capture the twists and turns of the street network.

The database contains street name and city boundary information for each street and includes the cities and towns through which each street passes and any aliases (for example US 101 in San Francisco which is also known as the Bayshore freeway and 19th Avenue) for a street.

Address information for each street is stored on a block by block basis allowing the ROGUE software to precisely locate residences and business.

Driving restrictions such as one-way streets, turn restrictions, and dead ends are stored in the database to prevent illegal directions.

Speed limit information is included for all arteries and streets for precise estimates of travel time.

Standard traffic patterns for each metropolitan area are included in the database so

congested areas can be avoided.

Road signs such as freeway entrance and exit ramp signs are stored for use in clarifying directions.

Additional information is stored where appropriate on a street by street basis including the following. This information may be flagged as always true or conditional on dates and/or times or vehicle properties.

- Construction
- Obstruction
- Repairs
- Road closed
- Bridge closed
- Barriers
- Chemical lane
- Explosive lane
- Flammable materials
- Radioactive materials
- Car pool lane
- Truck lane
- Bus Lane
- Parking availability
- Dirt road
- Private road
- Falling rock zone
- Deer crossing
- Rest stop
- Drawbridge
- Railway crossing

POINTS OF INTEREST - Locations of a variety of businesses and other points of interest, including the following, are stored in the database and may be used as destinations by the ROGUE software. Hours of operation, phone numbers and other useful information regarding these points are also stored.

- Transit system offices
- Bus/train/subway
- Newspapers
- Copy machines
- Pubs/Taverns
- Parking lots
- Shopping centers
- Major businesses
- Office buildings
- Industrial complexes

HAR 102380

MAR-17-2006 14:56

SAE

724 776 0002 P.16

881177

13

- Theatres
- Amusement parks
- Museums
- Sports complexes
- Athletic clubs
- Restaurants
- Drug stores
- Barber shops
- Tailors/Cleaners
- Liquor stores
- Hospitals
- Emergency centers
- Car dealers
- Government offices
- Parks
- Libraries
- Fire and Police
- Places of worship
- Schools
- Hotels
- Gas stations

OTHER DATABASE INFORMATION -
Information is also contained in
the database for:

- Scenic routes
- Bus routes
- Subways/Railways
- Walkways
- Waterways
- Cycle paths

FUTURE EXTENSIONS

Although not included in
initial versions of the ROGUE
software, the following
extensions to the software are
contemplated for the future:

VOICE INPUT - Voice
recognition hardware to allow
verbal command of the software
while driving.

VEHICLE INSTRUMENTATION -

Interface to vehicle fuel and
fluid level indicators to allow
automatic inclusion of needed
service stops in directions.

BROADCAST DATABASE AND
TRAFFIC UPDATES - Interface to
cellular telephone or FM radio
broadcasts for real time
transmission of updates to the
ROGUE database and traffic
condition information.

SUMMARY

Designing a route guidance system
for use by consumers requires the
provision of sophisticated
services in any easy to use
format. By combining modern
software technology with a
sophisticated database of road
information, ROGUE provides an
OEM platform for such systems.

ACKNOWLEDGMENTS

The author wishes to acknowledge
the existence of other, somewhat
similar, prototype systems for
providing in-vehicle route
guidance including those
described in the following
publications.

1) Thoone, M.L.G.: CARIN, a car
information and navigation
system, Philips Technical Review
42:11/12, December 1987.

2) Pilsak, O.: EVA - An
Electronic Traffic Pilot for
Motorists, SAE Paper 860346.

HAR 102381

MAR-17-2006 14:56

SAE

724 776 0002 P.17

Positions and opinions advanced in this paper are those of the author(s) and not necessarily those of SAE. The author is solely responsible for the content of the paper. A process is available by which discussions will be printed with the paper if it is published in SAE Transactions. For permission to publish this paper in full or in part, contact the SAE Publications Division.

Persons wishing to submit papers to be considered for presentation or publication through SAE should send the manuscript or a 300 word abstract of a proposed manuscript to: Secretary, Engineering Activity Board, SAE.

Printed in U.S.A.

TOTAL P.17

HAR 102382

Exhibit

HH

United States Patent [19]

Nimura et al.

[11] Patent Number: 4,882,696

[45] Date of Patent: Nov. 21, 1989

[54] NAVIGATION APPARATUS

[75] Inventors: Mitsuhiro Nimura; Shoji Yokoyama,
both of Anjo, Japan[73] Assignees: Aisia Aw Co., Ltd.; Kabushiki Kaisha
Shinsangyokaihatu, both of Aichi,
Japan

[21] Appl. No.: 217,532

[22] Filed: Jul. 11, 1988

[30] Foreign Application Priority Data

Oct. 7, 1987 [JP] Japan 53-173613

[51] Int. Cl.⁴ G06F 15/50[52] U.S. Cl. 364/449; 364/444;
73/178 R; 340/988[58] Field of Search 364/443, 444, 449, 436,
364/460, 424.02; 73/178 R; 340/988, 990, 995;
369/21

[56] References Cited

U.S. PATENT DOCUMENTS

4,291,373	9/1981	Mizote et al.	369/21
4,490,717	12/1984	Saito	364/460
4,630,209	12/1986	Saito et al.	364/449
4,679,147	7/1987	Tsujii et al.	364/449
4,688,176	8/1987	Hirata	364/449
4,774,671	9/1988	Itoh et al.	364/444
4,812,845	3/1989	Yamada et al.	340/995

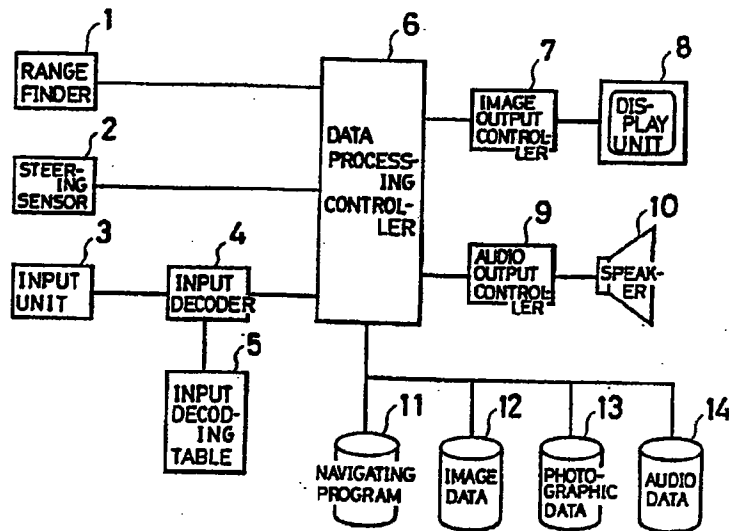
Primary Examiner—Gary Chin

Attorney, Agent, or Firm—Varndell Legal Group

[57] ABSTRACT

A navigation apparatus for navigating a vehicle in accordance with a preset course while measuring distance travelled and steering angle has voice track indication means in which voice track indications corresponding to the distance remaining to an intersection at which the next turn is to be made are outputted as the intersection is approached. When the distance from this intersection to the next intersection requiring a turn is less than a predetermined value, a voice track indication pointing out a lane into which the vehicle should be steered following the turn at the former intersection is outputted after the final voice track indication given just before the vehicle reaches this intersection. When it is required that a turn be made at the latter intersection immediately after the turn at the former intersection, the lane information for the turn at the latter intersection is outputted before the vehicle is turned at the former intersection. This makes it possible for the driver to steer the vehicle to the lane appropriate for the turn at the latter intersection while the vehicle is being turned at the former. Accordingly, in situations where it is required to make the turn at the latter intersection immediately after effecting the turn at the former, the driver can make the proper maneuvers smoothly and without haste.

5 Claims, 6 Drawing Sheets



HAR 093388

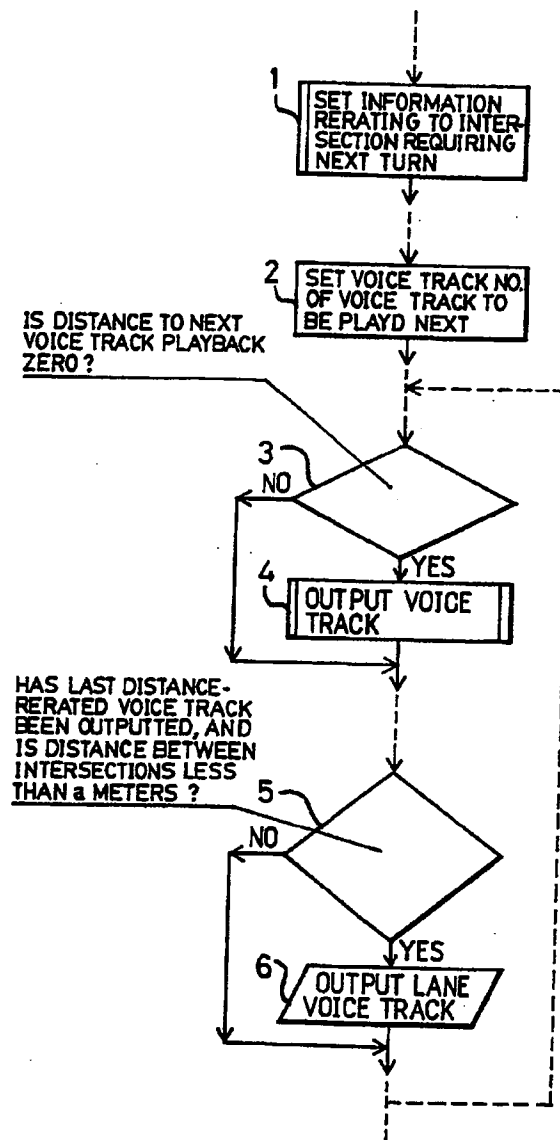
U.S. Patent

Nov. 21, 1989

Sheet 1 of 6

4,882,696

FIG. 1



HAR 093389

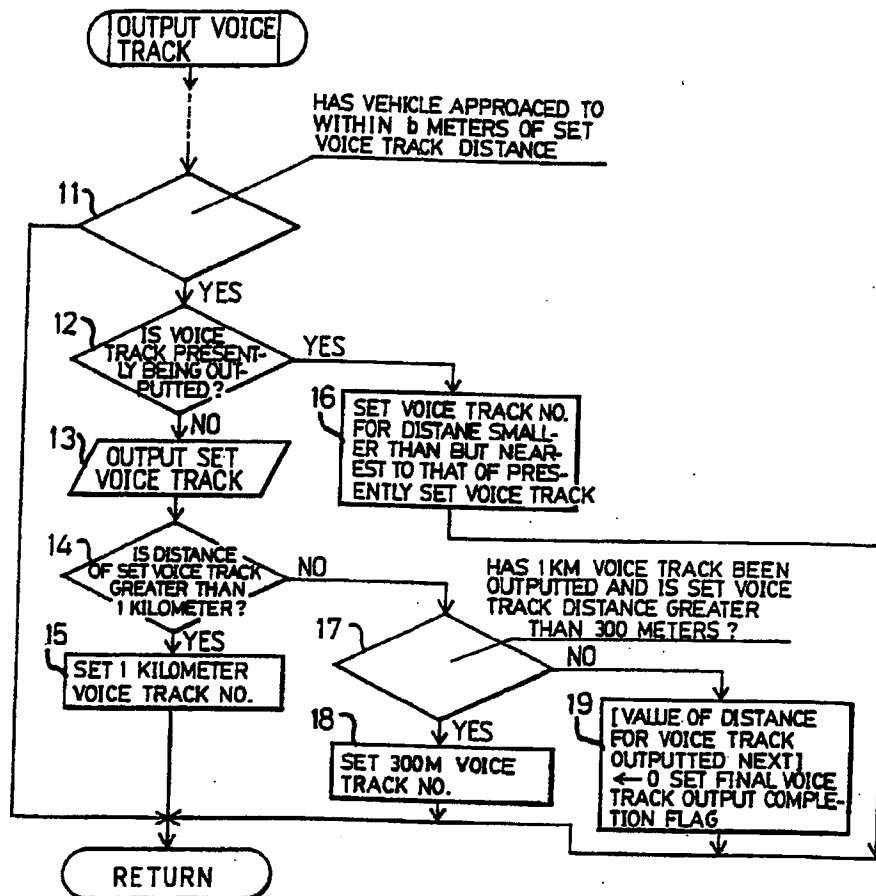
U.S. Patent

Nov. 21, 1989

Sheet 2 of 6

4,882,696

FIG. 2



HAR 093390

U.S. Patent

Nov. 21, 1989

Sheet 3 of 6

4,882,696

FIG. 3

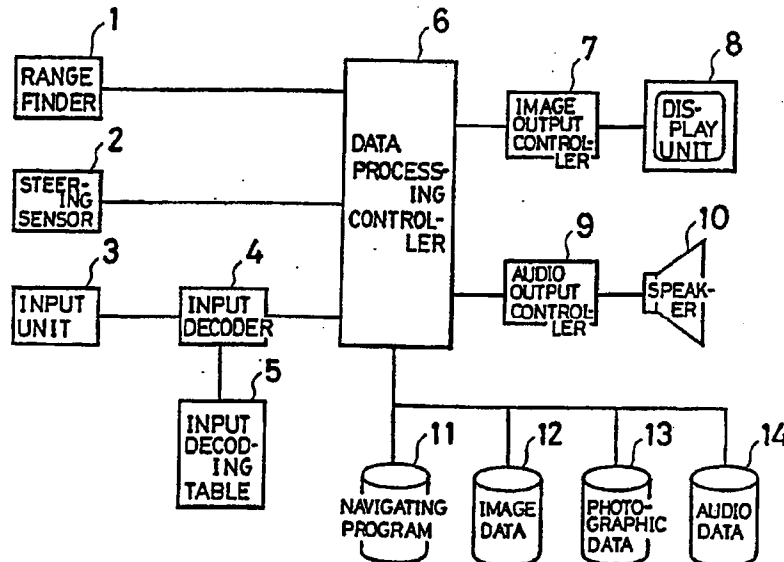
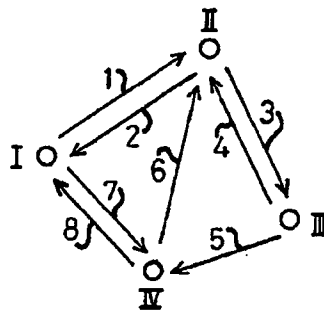


FIG. 4A



HAR 093391

U.S. Patent Nov. 21, 1989

Sheet 4 of 6

4,882,696

FIG. 4B

INTERSECTION NO.	INTERSECTION NAME	SMALLEST NO. OF ROAD HAVING THIS INTERSECTION AS STARTING POINT	SMALLEST NO. OF ROAD HAVING THIS INTERSECTION AS END POINT	TRAFFIC SIGNAL?
I	KANDA	1	2	YES
II	YUSHIMA	2	1	YES
III	—	4	3	NO
IV	—	6	5	

FIG. 4C

ROAD NO.	STARTING POINT	END POINT	NO. OF ROAD HAVING SAME STARTING POINT	NO. OF ROAD HAVING SAME END POINT	ROAD WIDTH	PROHIBITION ①	PROHIBITION ②	GUIDANCE UNNECESSARY	PHOTOGRAPH NO.	NUMBER OF NODES	LEADING ADDRESS OF NODE SERIES DATA	LENGTH
1	I	II	7	4	1	—	—	3	1	15	100	
2	II	I	3	8	1	—	—	7	2	13	200	
3	II	III	2	3	2	—	—	5	3	9	300	
4	III	II	5	6	2	—	—	2	4	20	500	
5	III	IV	4	7	2	—	—	8	5	25	600	
6	IV	II	8	1	1	6	—	—	6	30	700	
7	I	IV	1	5	0	3	2	—	7	9	800	
8	IV	I	6	2	0	—	—	1	8	3	900	

HAR 093392

U.S. Patent

Nov. 21, 1989

Sheet 5 of 6

4,882,696**FIG. 4D**

ADDRESS	EAST LONGITUDE	NORTH LATITUDE	ATTRIB- UTE
	135.5	35.1	0 1
	135.6	35.2	0 1
100			
200			

FIG. 5

INTERSECTION NAME
INTERSECTION NO.
PHOTOGRAPH NO.
ANGLE
DISTANCE
INTERSECTION NAME

HAR 093393

U.S. Patent

Nov. 21, 1989

Sheet 6 of 6

4,882,696**FIG. 6**

VOICE TRACK NO.	VOICE TRACK CONTENTS
1	ONE KILLOMETER TO THE INTERSECTION
2	300 METERS TO THE INTERSECTION
3	TURN RIGHT AT THE NEXT INTERSECTION
4	TURN LEFT AT THE NEXT INTERSECTION
5	BEAR RIGHT AFTER TURNING
6	BEAR LEFT AFTER TURNING
7	ENTER RIGHT LANE AFTER TURNING
8	ENTER LEFT LANE AFTER TURNING
⋮	⋮
⋮	⋮
⋮	⋮

HAR 093394

4,882,696

1

NAVIGATION APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for navigating a vehicle in accordance with a course set before travel starts. More particularly, the invention relates to a system for outputting intersection distance information in a navigation apparatus which provides traffic lane information after the vehicle has turned at an intersection.

Recent years have seen extensive development of vehicular navigation systems in which a course is preset before travel starts and the driver is given course information in accordance with the preset course.

When the driver is guided along the preset course, the conventional navigation apparatus merely displays a map on the screen of a CRT and superimposes the course on the map. Accordingly, observes the course displayed on the map and decides at which intersection the next turn is to be made.

However, with the conventional arrangement in which the driver determines the intersection by observing the course on the map, the driver is constrained to read his present position, the distance to the intersection and characterizing features near the intersection from the course display while driving the vehicle, and the driver must visually identify the intersection at which the next turn is to be made. This usually requires that the driver give his utmost attention to the task of identifying the intersection. Accordingly, since the driver's concentration is focused on identifying the proper intersection, he cannot give due consideration to, and is not aware of, the manner in which the vehicle should be steered after the turn at this intersection is made. If one intersection requiring a turn immediately follows another, the vehicle must be steered into the proper lane immediately after the turn at the first intersection is made. With the conventional system, however, the driver cannot determine which is the proper lane. This can cause the driver to make a dangerous lane change or to completely pass through the second intersection without making the turn.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a navigation apparatus in which a driver is so guided as to be capable of steering the vehicle along the optimum course even when there is a very short distance between intersections requiring turns.

Another object of the invention is to provide a navigation apparatus which provides appropriate intersection information before a turn is made at the first intersection.

In accordance with the invention, the foregoing objects are attained by providing a navigation apparatus for navigating a vehicle in accordance with a preset course while measuring distance travelled and steering angle, characterized by having voice track indication means in which voice track indications corresponding to the distance remaining to an intersection at which the next turn is to be made are outputted as the intersection is approached, wherein when the distance from this (first) intersection to the next (second) intersection requiring a turn is less than a predetermined value, voice track indication pointing out a lane into which the vehicle should be steered following the turn at the first intersection is outputted after the final voice track indi-

2

cation given just before the vehicle reaches the first intersection.

In accordance with the invention as described above, when it is required that a turn be made at the second intersection immediately after the turn at the first intersection, the lane information for the turn at the second intersection is outputted before the vehicle is turned at the first intersection. This makes it possible for the driver to steer the vehicle to the lane appropriate for the turn at the second intersection while the vehicle is being turned at the first intersection. Accordingly, in situations where it is required to make the turn at the second intersection immediately after effecting the turn at the first, the driver can make the proper maneuvers smoothly and without haste.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flowchart for describing an embodiment of a method of outputting intersection information in the navigation apparatus of the invention;

FIG. 2 is a flowchart illustrating the flow of processing for a voice track output routine;

FIG. 3 is a block diagram illustrating an example of the structure of a navigation system to which the intersection information output method of the inventive navigation apparatus is applied;

FIGS. 4A through 4D are views illustrating an example of basic data for creating navigation data;

FIG. 5 is a view illustrating an example of loop data constituting navigation data; and

FIG. 6 is a view illustrating an example of a voice track list.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will now be described with reference to the drawings.

As set forth above, a vehicular navigation apparatus provides a driver with course guidance in accordance with a course set before the start of travel. A feature of the present invention is that such a navigation apparatus is provided with means for outputting voice tracks. With regard to course guidance relating to intersections, the arrangement of the invention is such that voice tracks can be played to recite messages such as "ONE KILOMETER TO THE INTERSECTION", "300 METERS TO THE INTERSECTION", "TURN RIGHT AT THE NEXT INTERSECTION" when the vehicle approaches an intersection at which the next turn is to be made, thus providing the driver with an audible indication of the distance to the intersection and the direction of the turn. If there is but a short distance between the upcoming intersection requiring the turn and the intersection at which the next turn is to be made, voice tracks can be played to recite messages such as ① "BEAR RIGHT AFTER TURNING", ② "BEAR LEFT AFTER TURNING", ③ "ENTER THE RIGHT LANE AFTER TURNING", ④ "ENTER THE LEFT LANE AFTER TURNING" when the vehicle approaches the upcoming

HAR 093395

4,882,696

3

intersection requiring the turn. By way of these voice tracks, the driver is provided with traffic lane information concerning the lane to be entered after making the first turn. Voice quality is changed to distinguish between the voice tracks, as by outputting the information relating to the right-hand direction [1, 3] using a male voice and the information relating to the left-hand direction [2, 4] using a female voice. Thus, if the driver should fail to hear the details of the message when it is announced, he will still be able to ascertain the lane information by recalling whether the voice was that of a male or female.

With the arrangement of the invention, therefore, information relating to a lane which should be entered after a turn is made at an intersection is obtained before the turn. Accordingly, even if a course requires that one turn at an intersection be immediately followed by another, the driver is capable of steering the vehicle into the proper lane ahead of time to avoid making a hasty turn at the latter intersection. As a result, the driver is always placed at ease and need not make sudden lane changes or cut into traffic.

A flowchart of processing for outputting the aforementioned lane information will now be described with reference to FIG. 1.

1 First, information relating to the intersection at which the next turn should be made is set. This information includes the name of the intersection, the distance to this intersection and the direction in which the vehicle is to travel from this intersection.

2 The voice track numbers of previously prepared voice tracks are set based on the distance from the present vehicle position to the intersection requiring the next turn and the direction of travel from this intersection. Also set is the distance to the intersection requiring the next turn and for which the corresponding voice track is to be outputted.

3 It is determined whether the distance to the next voice track playback is zero.

4 If the answer received at step 3 is YES, then the voice track output processing of steps 11 through 19, which is described below with reference to FIG. 2, is executed.

5 If the answer received at step 3 is NO, then it is determined whether the final distance-related voice track has been outputted and the distance between the next two intersections requiring turns is less than a meters.

6 If the answer received at step 5 is YES, namely if the final voice track concerning distance has been outputted and the distance between the next two intersections requiring turns is short, then a voice track is outputted that relates to lane information conforming to the direction in which the car should be turned to negotiate the latter intersection. If the answer received at step 5 is NO, then the program returns to step 3 and the same processing loop is executed again in accordance with the vehicle travel up to the intersection at which the next turn is to be made.

The voice track output processing of step 4 will now be described in detail with reference to the flowchart of FIG. 2.

11 It is determined whether the vehicle has approached to within a distance b meters of a set voice track. If the answer is NO, the program returns to the main routine, namely to the processing of step 5. If a YES answer is received, the program proceeds to a step 12.

4

12 Here it is determined whether a voice track is presently being outputted. If a YES answer is received, a step 16 is executed. If a NO answer is received, the program proceeds to a step 13.

13 Here the set voice track is outputted.

14 It is determined whether the distance of the voice track which has been set is greater than 1 km. If the answer is YES, then a 1 km voice track number is set at a step 15 and the program returns. If a NO answer is received, a step 17 is executed.

17 Here it is determined whether the 1 km voice track has been outputted and the distance for a set voice track is greater than 300 m. If the answer is YES, namely if the aforementioned distance is greater than 300 m, a 300 m voice track number is set at a step 18 and the program returns. If a NO answer is received, namely if the distance is less than 300 m, the value of the distance for the voice track outputted next is set to zero and a flag indicating completion of the final voice track output is raised at a step 19 after which the program returns.

16 If a YES answer is received in the processing of step 12, namely if a voice track is presently being outputted, a voice track number for a distance smaller than that for the presently set voice track but nearest to this distance is set together with the voice track output distance. The program then returns to the main routine.

Thus, if the distance to the intersection at which the next turn is to be made is more than 1 km, voice tracks reciting the remaining distances of 1 km and 300 m are played in succession while travelling distance is being measured. When the distance to the intersection at which the next turn is to be made is less than 1 km, the voice track for the distance to this intersection is played [step 4]. If the final distance-related voice track has been played and the distance between the abovementioned intersection and the intersection requiring the next turn is less than a meters [YES at step 5], then lane information is outputted as by a voice track reciting "BEAR RIGHT AFTER TURNING" [step 6].

FIG. 3 illustrates an example of the system configuration of a navigation apparatus which performs the above-described course guidance.

In FIG. 3, the arrangement includes a range finder 1, a steering angle sensor 2, an input unit 3, an input decoder 4, an input decoding table 5, a data processing controller 6, an image output controller 7, a display unit 8, an audio output controller 9, a speaker 10 and files 11 through 14.

The range finder 1 measures the distance travelled by an automotive vehicle. Examples of the range finder 1 include means for detecting and counting the number of revolutions of a wheel, means for detecting acceleration and double-integrating the result, etc. Other measuring means may also be employed. The steering sensor 2 senses whether the vehicle has turned at an intersection. By way of example, the steering sensor 2 employs an optical rotary sensor or a rotating-type variable resistor attached to a rotating part of the steering wheel. The input unit 3 is a joy stick, key or touch-type panel. Alternatively, the input unit 3 can be interlocked with the screen of a display unit 8, and a key or menu can be displayed on the screen to enable inputs to be made from the screen. The input decoder 4 is adapted to decode input data from the input unit 3 while referring to the input decoding table 5. When a course is to be set, for example, the present location of the vehicle and the destination are inputted in the form of codes, where-

HAR 093396

5

4,882,696

6

upon the input decoder 4 effects a conversion into present location data and destination data based on the codes by referring to the input decoding table 5. Accordingly, the input decoding table 5 is set in accordance with the data inputted from the input unit 3. The data processing controller 6 is the brain of the navigation system. When a course has been selected and set at the input unit 3, the controller 6 calls and executes navigation data for this course from the file 11 storing the data.

Each item of navigating data is designed to display an information map, which is in line with the course travelled, on the screen of the display unit 8, project characteristic photographs at intersections and at points along the course, display remaining distances to intersections as well as other guidance information, and give audible information in the form of voice tracks broadcast from the speaker 10. These images, photographs and audio data are stored in files 12 through 14, respectively. The outputting of images to the display unit 8 is controlled by the image output controller 7, and the outputting of audio to the speaker 10 is controlled by the audio output controller 9.

As an example, assume that a road network comprises intersection numbers I-IV and road numbers ①-⑧, as shown in FIG. 4A. In such case, the intersection data will have the data configuration shown in FIG. 4B, the road data will have the data configuration shown in FIG. 4C, and the node series data will have the data configuration shown in FIG. 4D.

As shown in FIG. 4B, the intersection data comprises intersection names corresponding to the intersections numbers I-IV, road numbers having the smallest numbers among those roads possessing a certain intersection as a starting point, road numbers having the smallest numbers among those roads possessing a certain intersection as an end point, and information indicating whether or not a certain intersection has a traffic signal.

As shown in FIG. 4C, the road data comprises starting and end points, in the form of intersection numbers, of the road numbers ① through ⑧, the numbers of roads having the same starting point, the numbers of roads having the same end point, road width, information relating to prohibitions, information relating to guidance not required, photograph numbers, the numbers of nodes, the leading addresses of node series data, length, etc.

As shown in FIG. 4(D), the node array data comprises information relating to east longitude, north latitude, attributes and the like. The units of the road numbers comprise a plurality of nodes, as is evident from the road data. More specifically, the node data is data relating to one point on a road. If a line connecting nodes is referred to as an arc, a road is expressed by connecting each of a plurality of node arrays by arcs. For example, with regard to road number ①, the road comprises 15 nodes and the leading address of the node array data is 100, based on the road data. Therefore, road number ① is composed of node data having addresses 100 to 114.

Let us take intersection number I as an example. For a course having this intersection as a starting point, first road number ① is retrieved from the starting point information of the intersection point data, then road number ⑦ is retrieved from the road data relating to the road number ①, namely from the column reading "NO. OF ROAD HAVING SAME STARTING POINT". Since the same information for road number

⑦ will, in converse fashion, lead to retrieval of road number ①, one can determine that there are no other road numbers available as peripheral roads. The same will hold true with regard to end points. Further, since road number ⑥ will be prohibited in case of road number ⑤ in the road data, the vehicle will not be able to enter road number ⑥ from road number ⑤ at the intersection number IV shown in FIG. 4A because turns are prohibited at this intersection. The only road that can be entered is the road number ⑧. Accordingly, guidance to road number ⑧ is unnecessary. By providing the road data with road numbers indicative of roads that cannot be entered because of prohibited turns and road numbers indicative of roads for which guidance is not required, the necessary information storage capacity can be reduced and route retrieval can be facilitated. By relying upon such data, peripheral roads from an intersection (with the exception of roads for which entry is forbidden because of prohibited turns or the like) are retrieved, road width, the need or lack of need for guidance and other conditions necessary for computing an ideal route are set, and the optimum route from the designated starting point to the destination is retrieved. In accordance with the retrieved ideal route, route data shown in FIG. 5 is created as navigation data. The route data comprises the intersections, in order of nearness, from the starting point to the destination along the retrieved optimum route.

In accordance with the above-described navigation system, the driver selects a course by entering his present location and desired destination from the input unit 3 before travelling. When this has been accomplished, the data processing controller 6 reads and executes the navigating program in file 1 corresponding to this course. In accordance with the course, and on the basis of the measurement information from the range finder 1 and steering sensor 2, the aforementioned execution of the data determines the vehicle, displays the course information map, present location and the like, and informs the driver of characteristic features and intersections along the route, via the display unit 8 and speaker 10. Furthermore, in order to assure the driver that he has not strayed off the course when the distance between intersections is great, for example, the driver may be informed by voice of characterizing features being passed, such as by a voice track reciting "YOU WILL SOON CROSS A BRIDGE", or a photograph of the characterizing feature being passed may be projected on the display screen. Also, a guidance map and the present location of the vehicle are displayed. When the vehicle approaches an intersection, intersection information is outputted by the display screen and voice tracks, and other suitable voice tracks are played, as mentioned earlier. The navigation data includes which data are to be used under what conditions, these data being taken from the files 12 through 14 storing the data for the abovementioned input outputs and the data for the voice track outputs. An example of a voice track list is as shown in FIG. 6.

The present invention is not limited to the embodiment described above but can be modified in various ways. For example, though it is mentioned in the foregoing embodiment that voice tracks are played using a male voice or female voice depending upon whether lane information is indicative of steering to the left or right, it will suffice if the quality of the voice tracks differ in accordance with the lane information.

HAR 093397

7

4,882,696

Thus, in accordance with the invention as described above, information relating to a lane which should be entered after a turn is made at an intersection is obtained before the turn. Accordingly, even if a course requires that one turn at an intersection be immediately followed by a turn at another intersection, the driver is capable of steering the vehicle into the proper lane ahead of time to avoid making a hasty turn at the latter intersection. As a result, sudden lane changes and cutting into traffic can be avoided and it is possible for the driver to drive the vehicle at ease with sufficient time for making maneuvers.

8

DESCRIPTION OF APPENDIX

The attached material is an example of specific navigation data in C language to which the present invention is applied: For example:

a is a processing for setting information indicative of an intersection at which the next turn is to be made (see step ① of FIG. 1);

b is a processing step for setting the number of a voice track to be played next (see step ② of FIG. 1);

c is steps ③ and ④ shown in FIG. 1;

d is steps ⑤ and ⑥ shown in FIG. 1;

e is a routing for the above-mentioned *b*;

f is a routing for voice track output processing (see FIG. 2).

APPENDIX (A)

```
#include "nv.vns"
#include "dspguid.vns"
#include "retdef.vns"
#include "guidreco.nh"
#include "extern.nh"
#define NULL 0
#define CHKTIME 2000 /*20[s]*/
#define VOICETIME 400 /*5[s]*/
#define VNEARRIGHT 70
#define VNEARLEFT 38

extern int TIR_TIME;

int nxtguid (gno, nnvd, nvd, restd, drc, d100m)
int gno;
unsigned nnvd;
struct nvd *nvd;
unsigned *restd;
int *drc;
unsigned d100m;
{
    int ret;
    char cname[100];
    int frmno, frm[3][2][2];
    int bcolor=0;
    unsigned vdist=0;
    int pctno, angle;
    int f=0, f500=1;
    unsigned brestd;
    int neartrack;
    int killvoice;

    char btxt[30];
    int vtrack=0;

    brestd=*restd;
    pctno=nvd->pctno[0];
    angle=nvd->angle;
    strcpy(cname, &(nvd->name[0]));
    GUIDSW=0;
}
```

HAR 093398

9

4,882,696

10

```

tirqmsk(1);
if(ARIV==0) {
    while(*restd>d100m) {
        ret=intnvl();
        if(ret<=RETRESET) return(ret);
    }
}

```

APPENDIX(B)

```

if(*restd>500) {
    GUIDSW=1;
    FPOS=1;
    aview(1);
}
else aview(gno);

if(GUIDNO!=nnvd-1) {
    if(0!=(ret=nxtcrs(gno, cname, *restd, (drc+(GUIDNO-1)*256), pctno,
        &frmno, frm))) {
        if(ret<=RETRESET)
            return(ret);
        else {
            return -1;
        }
    }
}
else {
    if(0!=(ret=neartarg(gno, cname, angle, pctno, *restd))) {
        if (ret <=RETRESET)

else aview(gno);

if(GUIDNO!=nnvd-1) {
    if(0!=(ret=nxtcrs(gno, cname, *restd, (drc+(GUIDNO-1)*256), pctno,
        &frmno, frm))) {
        if(ret<=RETRESET)
            return(ret);
        else {
            return -1;
        }
    }
}
else {
    if(0!=(ret=neartarg(gno, cname, angle, pctno, *restd))) {
        if(ret<=RETRESET)
            return(ret);
        else return -1;
    }
    frmno=0;
    f=1;
}
}

```

HAR 093399

11

4,882,696

12

APPENDIX (C)

```

/*tirqmsk(1); printf("NVD[GUIDNO+1].restd<=300 %d\n", NVD[GUIDNO+1].restd);
tirqmsk(0);*/

```

```

    setvoice(f, *restd, angle, &vdist, &vtrack);

```

```

    bcolor=0;
    setmem(btxt, 15, 0x00);

```

```

while(FCHGNV==0) {
    if(0!=(ret=mguid(gno,0,*restd, &bcolor, btxt, frmno, frm))) {
        if(ret<=RETRESET) {
            if(FVDSP==0) {
                tirqmsk(1);
                if(FPOS==0) FPOS=1;
                while(1) {
                    if(FVDSP==1) (FPOS=0; break);
                    tirqmain();
                }
                tirqmsk(0);
            }
            else
                FPOS=0;
            return(ret);
        }
    }
}

```

```

/*
    if(vdist) {
        tirqmsk(1);
        neartrack=playvoice(*restd, &vdist, &vtrack, f, angle);
        printf("NEARTRACK == %d\n", neartrack);*/
        tirqmsk(0);
    }

```

```

    if(f500==1 && *restd<500+30) {
        GUIDSW=0;
        if(brestd>500) pippi();
        f500=0;
    }

```

```

/*
    if(FVOICE && (CVOICE > (VOICETIME/TIR_TIME))) {
        tirqmsk(1);
        cdready(1);
        printf("KILL VOICE\n"); */
        killvoice=1;
        tirqmsk(0);
    }

```

APPENDIX (D)

```

    else
        FPOS=0;
    return(ret);

```

HAR 093400

```

13
4,882,696
14
    }
    if(vdist) {
        tirqmsk(1);
        neartrack=playvoice(*restd,&vdist,&vtrack,f,angle);
/*      printf("NEARTRACK == %.d\n",neartrack);*/
        tirqmsk(0);
    }

    if(f500==1&&*restd<500+30) {
        GUIDSW=0;
        if(brestd>500) pippi();
        f500=0;
    }

    if(FVOICE&&(CVOICE>(VOICETIME/TIR_TIME))) {
        tirqmsk(1);
        cdready(0);
/*      printf("KILL VOICE\n");*/
        killvoice=1;
        tirqmsk(0);
        FVOICE=0;
    }

    if(neartrack && GUIDNO<NNVD-1 && NVD[GUIDNO+1].restd<=300) {
/*      tirqmsk(1);
        printf("At soon. ??? is. .\n");*/
        if(killvoice==1) {
            CVOICE=0;
            FVOICE=1;
            killvoice=0;
            neartrack=0;
            if(NVD[GUIDNO+1].angle<0) play_i(NVEARRIGHT);
            if(NVD[GUIDNO+1].angle>0) play_i(VNEARLEFT);
        }
        tirqmsk(0);
    }
}
return 0;

```

APPENDIX (E)

```

/*#define MAIN*/
#ifdef MAIN
unsigned VOICEDST;
char VOICETRACK;
void main(argc,argv)
int argc;
char *argv[];
(int arrive; int angle; unsigned restd;
    if(argc<4)
    { printf("NOW please input[arrive restd angle]!!!"); exit(); }
    printf("please input [arrive restd angle]!!!"); exit(); }
Play_1(0);
stcd_i(argv[1],&arrive);
stcd_i(argv[2],&restd);

```

HAR 093401

```

15
4,882,696
16
    stcd_i(argv[3], &angle);
    printf("SETVOICE RET:  %d\n", setvoice(arrive, restd, angle));
    printf("VOICE TRACK :  %d\n", VOICETRACK);
    printf("PLAY RET   :  %d\n", Play_I(VOICETRACK));
}
#endif

/*
    Obtain remaining distance(from RESTD) for guidance
    Set to VOICEDST
    Set guidance voice track NO. to VOICETRACK
    LEADING:    RUNNING()
*/
#include "voice.vns"
#include "nv.vns"
#include "guidreco.nh"
#include "extern.nh"
#define NVOICE 9
#define VDELTA 10+20

```

APPENDIX(F)

```

int setvoice(arriv, restd, angle, vdist, vtrack)
int arriv;
int angle; /*NVD[GUIDNO],angle*/
unsigned restd; /*RESTD*/
unsigned *vdist;
int *vtrack;
int i;

static unsigned voicedist[9]=
{ 100, 200, 300, 500, 1000, 2000, 3000, 5000, 10000};
static char voiceleft[9]={ 24, 25, 26, 27, 28, 29, 30, 31, 32,};
static char voiceright[9]={ 49, 50, 51, 52, 53, 54, 55, 56, 57,};
static char voicearriv[9]={ 59, 60, 61, 62, 63, 64, 65, 66, 67,};

for(i=0; i<NVOICE; i++) if(restd<voicedist[i]) break;
if(i==0) *vdist=voicedist[0];
else *vdist=voicedist[--i];
if(arriv) *vtrack=voicearriv[i];
else if(angle<0) *vtrack=voiceright[i];
else if(angle>0) *vtrack=voiceleft[i];
else { *vdist=0; return -1; }
return 0;
}

```

```

int playvoice(restd, vdist, vtrack, arriv, angle)
unsigned restd;
unsigned *vdist;

```

```

int *vtrack;
int i;

```

```

static unsigned voicedist[9]=
{ 100, 200, 300, 500, 1000, 2000, 3000, 5000, 10000};
static char voiceleft[9]={ 24, 25, 26, 27, 28, 29, 30, 31, 32,};
static char voiceright[9]={ 49, 50, 51, 52, 53, 54, 55, 56, 57,};
static char voicearriv[9]={ 59, 60, 61, 62, 63, 64, 65, 66, 67,};
for(i=0; i<NVOICE; i++) if(restd<voicedist[i]) break;

```

HAR 093402

4,882,696

17

18

```

if(i==0)      *vdist=voicedist[0];
else          *vdist=voicedist[--i];
if(arriv)     *vtrack=voicearriv[i];
else if(angle<0) *vtrack=voiceright[i];
else if(angle>0) *vtrack=voiceleft[i];
else          *vdist=0; return -1; }
return 0;

```

APPENDIX (G)

```

int playvoice(restd,vdist,vtrack,arriv,angle)
unsigned restd;
unsigned *vdist;
int *vtrack;
int arriv;
int angle;
{
    static int once=0;
    int retv=0;

    if(*vdist==0) return 0;
    if(restd<(*vdist+VDELTA)) {
        pippi();
        if(play_i(-2)==0) {
            play_i(*vtrack);
            if(*vdist>1000) {
                once=1;
                setvoice(arriv,1000+50,angle,vdist,vtrack);
            }
            else if(*vdist>300 && once)
                setvoice(arriv,300+50,angle,vdist,vtrack);
            else {
                *vdist=0;
                once=0;
                retv=1;
            }
            CVOICE=0;
            FVOICE=1;
        }
        else setvoice(arriv,((*vdist)-50),angle,vdist,vtrack);
    }
    return (retv);
}

```

What we claim is:

1. A navigation apparatus for navigating a vehicle in accordance with a preset course while measuring distance travelled and steering angle, comprising:

detecting means for detecting, immediately before a first intersection, whether distance from the first intersection to a second intersection at which the next turn is to be made is less than a predetermined value;

memory means for storing a voice track indication of lane information indicative of a lane into which the vehicle is to be steered after a turn is made at the first intersection; and

voice track indication output means for outputting the voice track indication of said lane information on the condition that said distance detected by said detecting means is less than said predetermined value.

2. The apparatus according to claim 1, wherein said voice track indication output means outputs a voice track indication conforming to distance remaining to

said first intersection as said first intersection is approached, and outputs the voice track indication of said lane information, which is indicative of the lane into which the vehicle is to be steered after the turn is made at the first intersection, after a final voice track indication outputted immediately before said first intersection.

3. The apparatus according to claim 1, wherein said voice track indication output means outputs voice track indications having a voice quality which differs depending upon the lane information.

4. The apparatus according to claim 1, wherein said voice track indication output means outputs a voice track designation conforming to a remaining distance to said first intersection and a direction of travel from said first intersection.

5. The apparatus according to claim 1, wherein said lane information is indicative of a direction in which the vehicle should be turned to approach said second intersection.

* * * * *

HAR 093403

EXHIBIT II

CD containing
video exhibit filed
separately with Court
and opposing counsel

Filed Under Seal

Exhibit

JJ

Filed Under Seal

Exhibit

KK

Filed Under Seal

Exhibit

LL

Filed Under Seal

Exhibit

MM

EXHIBIT NN

CD containing
video exhibit filed
separately with Court
and opposing counsel

Filed Under Seal

Exhibit

OO

Filed Under Seal

Exhibit

PP

Exhibit

QQ



**Jamal
Edwards/Chicago/Kirkland-E
llis**

03/30/2007 10:43 AM

To "Pint, John" <jpint@proskauer.com>

cc Harman-MIT@kirkland.com, "MIT_Harman"
<MIT_Harman@proskauer.com>

bcc

Subject Re: MIT v. Harman International Industries, Inc., 05-10990
DPW (D. Mass.)

John:

As I told you on the telephone, Harman does not dispute MIT's construction of "speech generator" and will not be briefing its own construction in Harman's Markman brief.

Best,

JME.

JAMAL M. EDWARDS | KIRKLAND & ELLIS LLP

200 East Randolph Drive | Chicago, IL 60601 | ☎ (312) 861-3143 | ✉ (312) 660-0616 | 🌐

<http://www.kirkland.com/jedwards>

**PRIVILEGED & CONFIDENTIAL - PREPARED BY ATTORNEY - FORWARDING PROHIBITED WITHOUT
CONSENT**

IRS Circular 230 Disclosure: To ensure compliance with requirements imposed by the U.S. Internal Revenue Service, we inform you that any tax advice contained in this communication (including any attachments) was not intended or written to be used, and cannot be used, by any taxpayer for the purpose of (1) avoiding tax-related penalties under the U.S. Internal Revenue Code or (2) promoting, marketing or recommending to another party any tax-related matters addressed herein.

"Pint, John" <jpint@proskauer.com>

03/30/2007 10:39 AM

To "Jamal Edwards" <jedwards@kirkland.com>

cc "MIT_Harman" <MIT_Harman@proskauer.com>, Harman-MIT@kirkland.com
Subject MIT v. Harman International Industries, Inc., 05-10990 DPW (D. Mass.)

Jamal,

To confirm our telephone conversation from this morning, MIT understands that Harman is now agreeing that MIT's proposed construction of the "speech generator" element of claim 1 of the '685 patent is correct. Specifically, Harman agrees that the "speech generator" element should be construed as "A system capable of receiving output from the discourse generator and converting the output into an electronic signal which will generate speech in the voice apparatus." MIT further understands because Harman agrees with MIT's construction, Harman is not planning to submit briefing on the proper construction of the "speech generator" to the Court in Harman's *Markman* brief.

If this is incorrect, please let me know immediately.

2

Sincerely,
JWP

John Wayne Pint | PROSKAUER ROSE LLP
One International Place | Boston, MA 02110-2600
v: 617.526.9779 | f: 617.526.9899
jpint@proskauer.com | www.proskauer.com

To ensure compliance with requirements imposed by U.S. Treasury Regulations, Proskauer Rose LLP informs you that any U.S. tax advice contained in this communication (including any attachments) was not intended or written to be used, and cannot be used, for the purpose of (i) avoiding penalties under the Internal Revenue Code or (ii) promoting, marketing or recommending to another party any transaction or matter addressed herein.

This message and its attachments are sent from a law firm and may contain information that is confidential and protected by privilege from disclosure. If you are not the intended recipient, you are prohibited from printing, copying, forwarding or saving them. Please delete the message and attachments without printing, copying, forwarding or saving them, and notify the sender immediately.

=====
=====

EXHIBIT RR

CD containing
video exhibit filed
separately with Court
and opposing counsel

Exhibit

SS

Excerpts of
Patent Classification Definitions
for
Class 395 -- Information
Processing System Organization
December 1991

Complete copies available at the
Court's request.

U.S. PATENT AND TRADEMARK OFFICE

DOCUMENTATION ORGANIZATIONS



PATENT CLASSIFICATION DEFINITIONS

**CLASS 395 - INFORMATION PROCESSING
SYSTEM ORGANIZATION**

December 1991

The information contained herein is current through the date shown above.

- (1) Note. For a general statement of the scope of this subclass and the subclasses indented hereunder, see section II, A, of the class definition for this class (395)

SEARCH CLASS:

382, Image Analysis, subclasses 10+ for recognition involving image analysis.

2. **Speech signal processing:**
Subject matter under subclass 1 wherein the system performs operations or functions on signals which represent speech.

SEARCH CLASS:

381, Electrical Audio Signal Processing, Systems, and Devices, subclasses 36-50 for speech signal analysis not involving data processing.

3. **Fuzzy logic hardware:**
Subject matter under subclass 1 wherein the system includes a specific circuit arrangement for performing logic with more than two levels, e.g., nonbinary or analog logic systems.

10. **Knowledge processing:**
Subject matter under subclass 1 wherein the system or method (1) has the capacity to process knowledge (i.e., data comprised of an integrated collection of facts and relationships), (2) has the capacity to generate its own set of rules (e.g., trainable processors), (3) structurally duplicates the human brain (e.g., neural networks), (4) functionally duplicates a law of nature (e.g., inheritance, evolution, etc.), or (5) has the capacity for solution of problems in these areas.

- (1) Note. This subclass and the subclasses indented hereunder provide for (1) knowledge processing solely, (2) applying knowledge processing to control in a generic environment, (3) applying knowledge processing to control in a specific environment where the environment is only nominally recited, or (4) applying knowledge processing solely to diagnostics in any environment.

- (2) Note. Where knowledge processing is used for control in a specific environment where the environment is fully recited and tied to the knowledge processing, classification is with the specific environment.

11. **Plural processing systems:**

Subject matter under subclass 10 comprising two or more systems, or methods utilizing two or more systems, wherein at least one system is a knowledge processing system.

- (1) Note. Subject matter of this subclass type includes, for example, plural expert systems, a nonknowledge-processing controller presetting a neural network, or an expert system programming a nonknowledge-processing controller.

12. **Graphical or natural language user interface:**
Subject matter under subclass 10 wherein presentation of data to the user of the system includes nonverbal representations or symbols, or statements in standard English language syntax.

13. **Genetic algorithms:**
Subject matter under subclass 10 wherein the system uses a sequence of steps that (1) starts with a group of solutions to a problem, (2) represents each solution as a coded data string, (3) divides and splices the coded numerical strings to create new solutions, and (4) determines the fitness of the new solutions.

20. **Trainable (i.e., adaptive) systems:**
Subject matter under subclass 10 wherein (1) the system creates its own set of rules (i.e., connection weights) (e.g., learns by example) or wherein (2) the data processing method involves in any way a system which creates its own set of such rules.